MINERAL COMMODITY SUMMARIES

1985

AN UP-TO-DATE SUMMARY OF 87
NONFUEL MINERAL COMMODITIES

This report is the earliest Government publication to furnish estimates covering 1984 nonfuel mineral industry data. Most of the estimates are based on 9 months data. These data sheets contain information on the domestic industry structure, Government programs, tariffs, and 5-year salient statistics for 87 individual minerals and metals. World resource data appearing in the statements have been provided by the Geological Survey.

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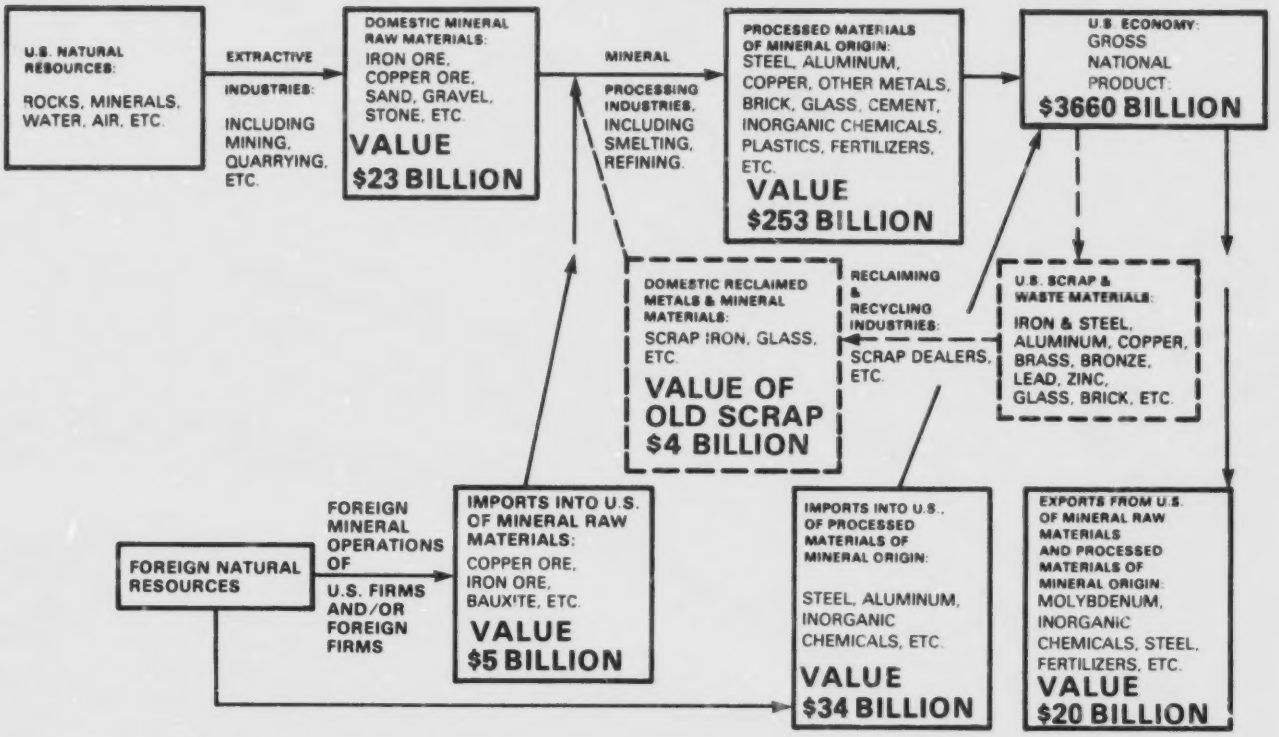
THE ROLE OF NONFUEL MINERALS IN THE U.S. ECONOMY

(ESTIMATED VALUES FOR 1984)*


U.S. NATURAL RESOURCES:
ROCKS, MINERALS, WATER, AIR, ETC.
EXTRACTIVE INDUSTRIES:
INCLUDING MINING, QUARRYING, ETC.
DOMESTIC MINERAL RAW MATERIALS:
IRON ORE, COPPER ORE, SAND, GRAVEL, STONE, ETC.
VALUE $23 BILLION
MINERAL PROCESSING INDUSTRIES, INCLUDING SMELTING, REFINING.
PROCESSED MATERIALS OF MINERAL ORIGIN:
STEEL, ALUMINUM, COPPER, OTHER METALS, BRICK, GLASS, CEMENT, INORGANIC CHEMICALS, PLASTICS, FERTILIZERS, ETC.
VALUE $253 BILLION
U.S. ECONOMY:
GROSS NATIONAL PRODUCT:
$3660 BILLION
DOMESTIC RECLAIMED METALS & MINERAL MATERIALS:
SCRAP IRON, GLASS, ETC.
VALUE OF OLD SCRAP $4 BILLION
RECLAIMING & RECYCLING INDUSTRIES:
SCRAP DEALERS, ETC.
U.S. SCRAP & WASTE MATERIALS:
IRON & STEEL, ALUMINUM, COPPER, BRASS, BRONZE, LEAD, ZINC, GLASS, BRICK, ETC.
FOREIGN NATURAL RESOURCES
FOREIGN MINERAL OPERATIONS OF U.S. FIRMS AND/OR FOREIGN FIRMS
IMPORTS INTO U.S. OF MINERAL RAW MATERIALS:
COPPER ORE, IRON ORE, BAUXITE, ETC.
VALUE $5 BILLION
IMPORTS INTO U.S., OF PROCESSED MATERIALS OF MINERAL ORIGIN:
STEEL, ALUMINUM, INORGANIC CHEMICALS, ETC.
VALUE $34 BILLION
EXPORTS FROM U.S. OF MINERAL RAW MATERIALS AND PROCESSED MATERIALS OF MINERAL ORIGIN:
MOLYBDENUM, INORGANIC CHEMICALS, STEEL, FERTILIZERS, ETC.
VALUE $20 BILLION

*DECEMBER 15, 1984-Base on statistics for first 10 months of 1984 only.

BUREAU OF MINES, U.S. DEPARTMENT OF THE INTERIOR
(based in part on U.S. Department of Commerce data)

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Selected Data on Nonfuel Metal and Mineral Production

Item	Unit	1982	1983	1984 e/	Percent change from 1983
Value of Nonfuel Process Minerals	Billion dollars	200.0	221.0	253.0	+14
U.S. Domestic Nonfuel Raw Minerals Production	do	19.7	21.1	22.7	+8
of which: Nonmetallics	do	14.2	15.3	16.7	+9
Metals from U.S. ores	do	5.5	5.8	6.0	+3
Steel (raw)	Million s. tons	74.6	84.6	93.0	+10
Steel (mill products)	do	61.6	67.6	73.3	+8
Iron Castings (shipments)	do	8.5	9.5	10.4	+9
Iron Ore (production)	Million l. tons	35.4	37.6	51.0	+36
Iron (purchased scrap)	Million s. tons	34.4	41.3	46.5	+13
Aluminum (primary)	Thousand m. tons	3,274	3,353	4,030	+20
Aluminum (secondary)	do	782	820	830	*
Bauxite (mine)	do	732	679	890	+31
Copper (mine)	do	1,140	1,038	1,050	*
Copper (refined - primary)	do	1,227	1,182	1,220	+3
Copper (refined - secondary)	do	468	401	310	-23
Lead (mine)	do	512	449	340	-24
Lead (refined - primary plus antimonial)	do	517	515	400	-22
Lead (secondary)	do	571	504	550	+9
Zinc (mine)	do	300	275	265	-4
Zinc (primary slab)	do	228	236	260	+10
Magnesium (primary)	Thousand s. tons	102	115	130	+13
Molybdenum (mine)	Million lbs.	84.4	34.0	99.0	+191
Nickel (refined metal from U.S. ores)	Short tons	3,456	W	8,000	W
Nickel (secondary)	do	43,000	51,000	50,000	*
Tungsten (mine)	Metric tons	1,575	1,016	1,300	+28
Vanadium (production - recoverable)	Million lbs.	8.2	4.3	5.6	+30
Antimony (primary - smelter)	Short tons	12,282	15,017	18,000	+20
Mercury (mine)	76-lb. flasks	25,760	25,070	19,100	-24
Mercury (secondary) 1/	do	4,473	13,474	4,000	-70
Gold (mine)	Million tr. oz.	1.47	1.96	2.30	+17
Gold (refinery - secondary)	do	3.04	2.96	3.00	*
Silver (mine)	do	40.2	43.4	44.0	*
Silver (refinery - secondary)	do	27.2	25.5	23.0	-10
Platinum-Group Metals (mine)	Thousand tr. oz.	8.0	6.0	6.0	-
Platinum-Group Metals (refinery - secondary)	do	344	287	370	+29
Tin (mine)	Metric tons	N e g l i g i b l e			
Tin (secondary)	do	9,582	10,766	11,000	*

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Includes releases by the General Services Administration of surplus mercury obtained from the Department of Energy.
* Less than 3%.

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Selected Data on Nonmetallic Mineral Production

Item	Unit	1982	1983	1984 e/	Percent change from 1983
Asbestos	Thousand m. tons	64	70	60	-14
Barite	Thousand s. tons	1,845	754	900	+19
Boron (B_2O_3)	do	607	637	680	+7
Bromine	Million pounds	401	370	340	-8
Cement (manufactured)	Thousand s. tons	63,355	70,420	78,000	+11
Clays	do	35,345	40,858	44,000	+8
Diatomite	do	613	619	640	+3
Feldspar	do	615	710	710	-
Fluorspar	do	77	e/61	70	+15
Gypsum	do	10,538	12,884	14,300	+11
Ilmenite	do	263	W	W	W
Lime (manufactured)	do	14,075	14,867	16,100	+8
Mica (scrap and flake)	do	106	140	150	+7
Peat	do	798	704	720	*
Perlite	do	506	474	500	+6
Phosphate Rock	Thousand m. tons	37,414	42,573	49,000	+15
Potash	do	1,784	1,429	1,600	+12
Pumice and Pumicite	Thousand s. tons	416	449	520	+16
Salt	do	37,651	32,973	38,750	+18
Sand and Gravel (construction)	Million s. tons	594	655	680	+4
Sand and Gravel (industrial)	do	27	27	29	+7
Sodium Carbonate	Thousand s. tons	7,819	8,467	8,350	*
Sodium Sulfate (natural)	do	864	423	530	+25
Sodium Sulfate (manufactured)	do	-	432	450	+4
Stone (crushed)	Million s. tons	790	863	950	+10
Stone (dimension)	do	1.33	1.19	1.23	+3
Sulfur (Frasch)	Thousand m. tons	4,210	3,202	4,000	+25
Sulfur (recovered)	do	4,404	4,955	5,200	+5
Sulfur (other)	do	1,[illegible]3	1,133	1,100	-3
Talc and Pyrophyllite	Thousand s. tons	1,135	1,066	1,230	+15
Vermiculite	do	316	282	320	+14

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
* Less than 3%.

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U.S. NET IMPORT RELIANCE 1/ OF METALS AND MINERALS AS A PERCENT OF APPARENT CONSUMPTION 2/
(In percent. Based on net imports of metals, minerals, ores, and concentrates.)

Metals and Minerals	1982	1983	1984 e/	Major Foreign Sources (1980-1983)
Aluminum (metal)	7	17	9	Canada, Ghana, Japan, Venezuela
Antimony	50	54	W	Metal: Bolivia, China, Bel.-Lux., Mexico Ore: Bolivia, Mexico, Canada, Rep. of South Africa Oxide: Rep. of South Africa, Bolivia, China, France
Arsenic	W	W	W	Sweden, Canada, Mexico, France
Asbestos	74	68	75	Canada, Rep. of South Africa
Barite	55	65	64	China, Morocco, Chile, Peru
Bauxite and alumina	96	96	96	Bauxite: Jamaica, Guinea, Suriname Alumina: Australia, Jamaica, Suriname
Beryllium	W	W	W	China, Brazil, Rep. of South Africa, Switzerland
Bismuth	W	W	W	Peru, Mexico, United Kingdom, Fed. Rep. of Germany
Boron	E	E	E	Colemanite: Turkey, Yugoslavia Boric acid: Turkey, France, Argentina, Mexico Ulexite: Turkey
Bromine	E	E	E	Israel, United Kingdom, France
Cadmium	73	72	56	Canada, Australia, Mexico, Peru
Cement	5	6	9	Canada, Spain, Mexico, Japan
Cesium (compounds)	100	100	100	Fed. Rep. of Germany
Chromium	85	76	82	Rep. of South Africa, Zimbabwe, U.S.S.R., Philippines
Clays	E	E	E	United Kingdom, Canada, Fed. Rep. of Germany, Mexico
Cobalt	92	95	95	Zaire, Zambia, Canada, Japan
Columbium	100	100	100	Brazil, Canada, Thailand
Copper	1	19	21	Chile, Canada, Mexico, Peru
Corundum	100	100	100	Drawdown of stocks of material imported from Rep. of South Africa
Diamond (industrial stone)	100	100	100	Rep. of South Africa, Zaire, United Kingdom, Bel.-Lux.
Diamond (bort, powder, dust)	E	E	E	Ireland, Rep. of South Africa, Japan, United Kingdom
Diatomite	E	E	E	Mexico
Feldspar	E	E	E	Canada, Sweden, Norway
Fluorspar	90	90	91	Mexico, Rep. of South Africa, China, Italy
Gallium	NA	NA	NA	Switzerland, Fed. Rep. of Germany, Canada
Garnet	E	E	E	None
Gem stones	100	100	100	Bel.-Lux., Israel, Rep. of South Africa, India
Germanium	NA	NA	NA	Bel.-Lux., United Kingdom, Fed. Rep. of Germany, China
Gold	32	19	16	Canada, Switzerland (mostly Rep. of South Africa origin), Uruguay
Graphite (natural)	W	W	W	Mexico, China, Brazil, Madagascar
Gypsum	36	40	38	Canada, Mexico, Spain
Hafnium	W	W	W	France, Fed. Rep. of Germany, United Kingdom
Helium	E	E	E	None
Ilmenite	74	W	W	Australia, Canada, Rep. of South Africa
Indium	NA	NA	NA	Bel.-Lux., France, Italy, United Kingdom
Iodine	W	W	W	Japan, Chile
Iron ore	34	37	19	Canada, Venezuela, Liberia, Brazil
Iron and steel	20	16	23	Japan, Europe, Canada
Iron and steel scrap	E	E	E	Canada
Iron and steel slag	NA	NA	NA	Not available
Kyanite & related minerals	E	E	E	Not available
Lead (metal)	3	14	18	Canada, Mexico, Australia, Peru
Lime	2	2	!	Canada, Mexico
Lithium	E	E	E	China, Fed. Rep. of Germany, France
Magnesium	E	E	E	Canada, Norway, France, Italy
Magnesium compounds	4	7	6	Ireland, Greece, Canada, Japan

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U.S. NET IMPORT RELIANCE 1/ OF METALS AND MINERALS AS A PERCENT OF APPARENT CONSUMPTION 2/

(In percent. Based on net imports of metals, minerals, ores, and concentrates.)

Metals and Minerals	1982	1983	1984 e/	Major Foreign Sources (1980-1983)
Manganese	99	99	99	Ore: Rep. of South Africa, Gabon, Australia, Brazil Ferromanganese: Rep. of South Africa, France
Mercury	31	30	60	Spain, Japan, Mexico, Turkey
Mica (natural) scrap & flake	E	E	3	Canada, India
Mica (natural) sheet	100	100	100	India, Belgium, France
Molybdenum	E	7	E	Canada, Mexico
Nickel	76	75	74	Canada, Australia, Norway, Botswana
Nitrogen (fixed)	8	18	14	U.S.S.R., Canada, Mexico, Trinidad and Tobago
Peat	26	32	38	Canada, Fed. Rep. of Germany
Perlite	E	4	4	Greece
Phosphate rock	E	E	E	Morocco, Mexico, Netherlands Antilles
Platinum-group metals	81	90	91	Rep. of South Africa, United Kingdom, U.S.S.R.
Potash	65	75	74	Canada, Israel
Pumice & pumicite	22	29	29	Greece
Quartz crystal-industrial	NA	11	E	Brazil
Rare-earth metals	E	12	16	Monazite: Australia, Malaysia
Rhenium	W	W	W	Chile, Fed. Rep. of Germany
Rubidium	NA	NA	NA	Canada
Rutile	W	W	W	Australia, Sierra Leone, Rep. of South Africa
Salt	11	18	10	Canada, Mexico, Bahamas, Chile
Sand and gravel (construction)	E	E	E	Canada
Selenium	55	39	51	Canada, United Kingdom, Japan, Bel.-Lux.
Silicon	23	31	21	Canada, Brazil, Norway, Venezuela
Silver	55	61	61	Canada, Mexico, Peru, United Kingdom
Sodium carbonate	E	E	E	Canada
Sodium sulfate	27	21	4	Canada, Belgium, Mexico
Stone (crushed)	-	-	-	Canada, Bahamas
Stone (dimension)	51	54	57	Italy, Canada, Mexico, Portugal
Strontium	100	100	100	Mexico, Spain
Sulfur	4	15	17	Canada, Mexico
Talc and pyrophyllite	E	E	E	Canada, Italy, Australia, France
Tantalum	92	97	94	Thailand, Malaysia, Brazil, Canada
Tellurium	W	W	W	Canada, Hong Kong, United Kingdom
Thallium	100	100	100	Bel.-Lux., Fed. Rep. of Germany, Norway, Japan
Thorium	100	100	100	France, Netherlands, Canada, Malta
Tin	68	73	79	Thailand, Malaysia, Indonesia, Bolivia
Titanium (metal)	W	9	9	Japan, China, U.S.S.R.
Tungsten	42	52	71	Canada, China, Bolivia
Vanadium	24	26	41	Rep. of South Africa, Canada, Finland
Vermiculite	E	2	2	Rep. of South Africa, Brazil
Yttrium	100	100	100	Monazite: Australia, Malaysia
Zinc	58	65	67	Ore & Concentrates: Canada, Peru, Mexico Metal: Canada, Peru, Mexico, Australia
Zirconium	W	W	W	Zirconium: France, Japan, Canada Zircon: Australia, Rep. of South Africa

e/ Estimated.
E Net exports.
W Withheld.
NA Not available.
- None.

1/ Net import reliance = imports - exports + adjustments for Government and industry stock changes.

2/ Apparent consumption = U.S. primary + secondary production + net import reliance.

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ALUMINUM 1/

(Data in thousand metric tons of metal, unless noted)

1. Domestic Production and Use: In 1984, 12 companies operated 27 primary aluminum reduction plants, with 3 firms accounting for 57% of production. Washington, Oregon, and Montana accounted for 35% of the production; Indiana, Kentucky, Missouri, and Tennessee 25%; Alabama, Arkansas, Texas, South Carolina, and North Carolina 20%; other States 20%. Based on published producer prices, output of primary metal in 1984 was valued at $7.2 billion. Aluminum consumption by 25,000 firms was centered in the east-central United States. Packaging accounted for an estimated 35% of domestic consumption in 1984, transportation, 20%; building, 18%; electrical, 9%; consumer durables, 8%; and other uses, 10%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Primary	4,654	4,489	3,274	3,353	4,030
Secondary (from old scrap)	617	758	782	820	830
Imports for consumption	646	848	878	1,091	1,500
Exports	1,345	786	748	776	695
Consumption, apparent 2/	4,595	4,615	4,379	5,026	5,330
Price: Ingot, average, cents per pound					
U.S. producer list	71.6	76.0	76.0	77.8	81.0
U.S. market (spot)	76.1	59.8	46.8	68.3	62.0
Stocks: Aluminum industry, yearend	2,302	2,996	2,803	2,265	2,600
Employment: Primary reduction e/	23,000	21,000	19,000	21,000	20,000
Secondary smelter e/	4,200	4,000	4,000	4,000	3,800
Net import reliance 3/ as a percent of apparent consumption	E	4/E	7	17	9

3. Recycling: Aluminum recovery from scrap generated from current operations (new scrap) accounted for about 53% of the total recovery from purchased scrap. Discarded aluminum products (old scrap) such as cans accounted for the remainder. Aluminum recovery from old scrap estimated at 830,000 tons in 1984 was about 16% of apparent consumption.

4. Import Sources (1980-83): Canada 64%, Ghana 11%, Japan 6%, Venezuela 3%, Other 16%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Unwrought (in coils)	618.01	2.8% ad val.	2.6% ad val.	18.5% ad val.
Unwrought (other than aluminum silicon alloys)	618.02	0.2¢/lb	Free	11.0% ad val.
Wrought (bars, plates, sheets, strip)	618.25	3.0% ad val.	3.0% ad val.	13.5% ad val.

6. Depletion Allowance: None. 1/

7. Government Stockpile:

Stockpile Status-11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales 11 Months
Aluminum	635	2	-	-

e/ Estimated. E Net exports.
1/ See also Bauxite.
2/ Domestic primary metal production plus recovery from old aluminum scrap and net import reliance.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Increase in industry stocks exceeded net imports.

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8. Events, Trends, and Issues: Primary aluminum production continued to increase in 1984 as the U.S. economy continued its recovery from the 1980-1982 period. Metallic recovery from old scrap increased slightly, mainly from the recycling of used beverage cans. Total apparent consumption of aluminum increased as the demand for the transportation, building, and consumer durables industries continued to improve during 1984. The demand for the container and packaging industry remained high. Imports of ingot and other forms were estimated at 1.5 million tons, an increase of 37% over 1983. Exports declined to 695,000 tons, and the United States remained a net importer of aluminum. The producer list price for primary ingot remained at 81 cents per pound through November. Spot prices, as quoted by Metals Week, began the year at about 76 cents. By the end of January, spot prices began a decline which continued throughout the year. By the mid October, the spot price was 47 cents. Prices on commodity exchanges followed the declining trend of spot prices.

In 1984, U.S. primary producers began the year with 3.82 million tons, or 78%, of annual capacity in operation, and by May the operating rate increased to about 87% as producers started potlines to meet the increased demand. However, as world inventories increased and prices weakened, U.S. producers began shutting down potlines at some smelters. By yearend, the operating rate was down to about 75%. To encourage production in the Pacific Northwest, the Bonneville Power Administration reduced the power rate to the aluminum producers from 27.7 mills to 22.7 mills per kilowatt hour beginning September 1 for a period of 6 months provided the producers purchased a specific amount of energy on a take-or-pay basis. Capacity decreased 103,000 tons in February when the idle San Patricio, TX smelter closed permanently. Several companies announced their withdrawal from the aluminum business and initiated agreements to sell their aluminum interests.

It is estimated that in 1985 primary aluminum production will be about 3.6 million tons and apparent consumption will be about 5.2 million tons. The United States probably will continue as net importer of metal. From a 1981 base, a year of low apparent metal consumption, apparent demand for aluminum is expected to increase at an average annual rate of about 6.7% through 1990. High operating and uncertain energy costs are expected to lower the rate, or eliminate, smelter expansion and a low rate of domestic production growth is expected. Demand probably will have a greater reliance on imports and recovery of metal from old scrap.

9. World Plant Production and Capacity:

	Production		Yearend Capacity	
	1983	1984 e/	1983	1984 e/
United States	3,353	4,030	5,000	4,900
Australia	475	710	594	870
Canada	1,091	1,230	1,234	1,240
Germany, Federal Republic of	730	750	772	780
Norway	716	780	800	800
Other Market Economy Countries	4,695	4,750	6,101	6,240
China e/	381	380	382	380
U.S.S.R. e/	1,996	2,100	2,320	2,490
Other Centrally Planned Economies e/	428	440	546	600
World Total	13,865	15,170	17,749	18,300

10. World Resources: Domestic aluminum requirements cannot be met by domestic resources of bauxite. Potential resources of nonbauxitic aluminum materials in the United States are abundant and could meet domestic aluminum requirements. However, no plants have been built to treat such materials, nor have optimum processes been determined. The world reserve base of bauxite is sufficient to meet forecasted world demand well beyond the year 2000. 1/

11. Substitutes: As a substitute for aluminum, copper can be used for electrical applications. Magnesium and titanium may be used for structural and transportation uses. Steel may be used where weight saving is not important. Composites, wood, and steel may be used in the building and construction markets, and glass, plastics, paper, and steel may be used in the packaging market.

January 1985

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ANTIMONY

(Data in short tons of antimony, unless noted)

1. Domestic Production and Use: One company located in Idaho recovered antimony as a byproduct of complex silver-copper ores (tetrahedrite). A domestic mine in Montana that had produced antimony from stibnite ore reportedly closed its mining operations temporarily in 1984. Additional antimony was recovered from the smelting of lead ore. Primary antimony metal and oxide were recovered by nine companies utilizing both foreign and domestic raw materials. The estimated value of total primary plant production in 1984 was $69 million. Primary antimony was consumed at about 300 plants in States east of the Mississippi River, accounting for over 95% of reported primary consumption. The principal uses of primary antimony were flame retardants, 60%; transportation, including batteries, 15%; ceramics and glass, 10%; chemicals, 10%, and other, 5%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	343	646	503	838	W
Primary plants 1/	16,062	17,844	12,282	15,017	18,000
Secondary plants, total	19,893	19,856	16,596	14,204	14,000
Imports for consumption	17,996	17,970	13,387	12,885	25,000
Exports of metal, alloys, and oxide	1,371	776	1,107	669	1,000
Shipment from Govt. stockpile excesses	-	-	21	1,863	-
Consumption: Reported, primary antimony	11,239	11,592	9,414	10,873	11,000
Apparent 2/	32,917	35,205	30,922	29,712	W
Price: Average, cents per pound 3/	150.8	135.5	107.2	91.3	155.0
Stocks, yearend	8,411	9,158	5,973	3,935	7,000
Employment: Plant e/	130	130	130	130	130
Net import reliance 4/ as a percent of apparent consumption	47	47	50	54	W

3. Recycling: Approximately 12,600 tons of antimony, which was about 35% of the apparent domestic consumption of antimony was derived from old scrap. Over 90% of the total secondary antimony was recovered as antimonial lead. Most of the recovered antimonial lead was consumed by the battery industry.

4. Import Sources (1980-83): Metal--Bolivia 52%, China 29%, Belgium-Luxembourg 6%, Mexico 6%, Other 7%.
Ores and concentrate--Bolivia 49%, Mexico 20%, Canada 10%, Republic of South Africa 8%, Other 13%.
Oxide--Republic of South Africa 40%, Bolivia 19%, China 17%, France 14%, Other 10%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore	601.03	Free	Free	Free
Needle or liquated	603.10	0.1¢/lb.	0.1¢/lb.	0.25¢/lb.
Metal, unwrought	632.02	0.3¢/lb.	Free	2¢/lb.
Oxide	417.50	0.1¢/lb.	Free	2¢/lb.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Material	Goal	Stockpile Status--11-30-84 Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 months
Antimony	36,000	38,840	2,840	-

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Includes antimony recovered as antimonial lead from smelting lead ore.
2/ Domestic mine production + antimony recovered as antimonial lead from domestic lead ores + antimony recovered from old scrap + net import reliance.
3/ New York dealer price for 99.5% to 99.6% metal, c.i.f. U.S. ports.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.
6/ Excluding U.S. production.

Prepared by P. A. Plunkert, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: Overall improvement in the domestic economy led to an increase in production and apparent consumption of antimony in 1984. Imports for consumption, especially from China, increased dramatically over the previous year. The Defense Authorization Act for fiscal 1985 authorized the sale of 3,200 tons of antimony metal from the National Defense Stockpile. The General Services Administration, which will be handling this sales program, announced that it intended to limit the sale of antimony from the stockpile to 1,000 tons during fiscal year 1985.

Changes in the types of alloys used in automotive batteries have led to reduced use of antimony as a hardener in battery grids. Antimony has been replaced by alternate metals in some original equipment starting-lighting-ignition batteries but continued to be used in some replacement batteries. The decline in the use of antimony for batteries should continue to be offset by increased consumption of antimony oxide as a flame retardant which has become the dominant market for primary antimony.

From a 1983 base, demand for antimony is expected to increase at an average annual rate of about 1.1% through 1990. Reliance on imports of both metal and concentrates is expected to continue as domestic producers supply only a small portion of the primary demand. It is estimated that in 1985 U.S. apparent consumption will be 35,000 tons.

Environmental and ecological problems associated with the treatment of antimony metal and ores are minimal as emissions and effluents are controlled at the processing plants.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/
	1983	1984 e/	
United States	838	W	100,000
Bolivia	11,600	11,000	350,000
Mexico	1,700	1,700	250,000
South Africa, Republic of	6,947	8,000	280,000
Yugoslavia	1,500	1,500	100,000
Other Market Economy Countries	9,166	9,750	1,135,000
Centrally Planned Economies	21,550	21,550	2,960,000
World Total	53,301	6/53,500	5,175,000

10. World Resources: United States resources are mainly in Idaho, Nevada, Alaska, and Montana. Principal identified world resources, estimated at 5.6 million tons, are in China, Bolivia, the U.S.S.R., the Republic of South Africa, and Mexico. Additional antimony resources may occur in Mississippi Valley-type lead deposits in the Eastern United States.

11. Substitutes: Compounds of titanium, zinc, chromium, tin, and zirconium may be substituted for antimony chemicals in paint, pigments, frits, and enamels. Combinations of calcium, strontium, tin, copper, selenium, sulfur, and cadmium can be used as substitutes for hardening lead. Selected organic compounds and hydrated aluminum oxide are widely accepted alternative materials in flame-retardant systems.

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ARSENIC

(Data in metric tons of arsenic trioxide (As_2O_3), unless noted 1/)

1. Domestic Production and Use: Arsenic trioxide was recovered as a byproduct of the smelting of high-arsenic copper concentrates and arsenic-bearing residues. Production of crude arsenic trioxide (95% minimum purity) and arsenic metal came from one plant in Tacoma, WA, primarily from imported copper concentrates. One company in Conley, GA, refined imported low-grade arsenic trioxide (70%-90%) for use in the production of arsenical wood preservatives. Four producers of agricultural chemicals and two producers of wood preservative chemicals consumed most of the domestic supply of arsenic. Metallic arsenic was used primarily in nonferrous alloying. Approximately 10 tons of high-purity arsenic metal were used in the electronics industry for the production of semiconductor materials. The estimated end use distribution of arsenic in 1984 was 55% in industrial chemicals (wood preservatives), 35% in agricultural chemicals (herbicides and desiccants), 5% in glass, 3% in nonferrous alloys, and 2% in other uses.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production, refinery	W	W	W	W	W
Imports for consumption:					
Metal, arsenic content	241	293	136	243	300
Arsenic trioxide	11,365	17,198	14,598	10,186	12,000
Arsenic compounds, gross weight 2/	275	1,606	1,726	3,555	2,500
Exports, compounds, gross weight	1,518	523	2,658	85	75
Consumption apparent	W	W	W	W	W
Price, cents per pound, yearend:					
Trioxide, domestic, 95% As_2O_3, f.o.b. Tacoma, WA	32	40	40	33	33
Trioxide, Mexican, 99.13% As_2O_3, f.o.b. Laredo, TX	46	78	59	45	42
Metal, domestic, 99% As, 2000 lb. lots	300	275	245	225	210
Stocks, yearend, producer	W	W	W	W	W
Employment		Not available			
Net import reliance 3/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: None.

4. Import Sources (1980-1983): Sweden 32%, Canada 22%, Mexico 22%, France 11%, Other 13%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Metal	632.04	0.5c/lb	Free	Free
Trioxide & sulfide	417.62 & 417.60	Free	Free	Free
Other compounds	417.64	4.0% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Arsenic trioxide (As_2O_3) contains approximately 76% arsenic by weight.
2/ Arsenic compounds include other arsenic compounds (TSUS 417.64), arsenic sulfide (TSUS 417.60), arsenic acid (TSUS 416.05), sodium arsenate (TSUS 420.70), sheep dip (TSUS 493.75), and lead arsenate (TSUS 419.00).
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.
5/ Excluding U.S. production.

Prepared by D. L. Edelstein, telephone number (202) 634-1053.

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8. Events, Trends, and Issues: Demand for arsenic trioxide in 1984 increased above the low level of 1983, as reflected by the increase in imports, yet remained below the peak demand of 1981. The largest increase in demand was in agricultural usage. The principal agricultural market for arsenical herbicides and desiccants, cotton growing, was adversely affected during 1983 by the U. S. Department of Agriculture special program of payment in kind (PIK) for acreage diversion for 1983 crops. The program was not renewed for cotton during 1984.

It is estimated that in 1985 domestic mine production of arsenic will be 900 metric tons. From a 1983 base, adjusted to account for abnormal agricultural consumption for arsenic, demand for arsenic is expected to increase at an average annual rate of about 1.1% through 1990.

In July 1984 the Environmental Protection Agency (EPA) issued its final regulatory position on the use of arsenical compounds, creosote and pentachlorophenol wood preservatives. EPA classified the three preservatives for restricted use only by certified applicants, and specified workplace regulations and consumer education requirements on the handling and disposal of treated wood. No major impact on the wood preservative industry was anticipated as a result of the regulations.

In June, ASARCO Incorporated announced its plan to terminate copper smelting operations at its Tacoma plant by June 30, 1985. Asarco cited an expected $150 million cost necessary to comply with environmental regulations as being unjustifiable in light of copper market conditions. Following closure of the smelter, Asarco planned to continue to operate its arsenic production facility at Tacoma at a reduced level in order to process byproducts from its other smelters. Most of Tacoma's arsenic production has come from the smelting of imported high-arsenic copper concentrates. Proposed EPA regulations governing the Tacoma smelter and other sources of arsenic emissions, issued in 1983, have been partially negated by Asarco's decision to close the only domestic smelter treating high-arsenic copper concentrates. Final EPA standards are expected to be issued in 1985.

9. World Plant Production and Reserve Base:

	Plant Production		Reserve Base 4/
	1983	1984 e/	
United States	W	W	100,000
France	5,000	5,000	
Mexico	4,700	4,500	
Namibia	1,126	1,200	
Peru	1,800	2,000	1,750,000
Sweden e/	4,000	4,000	
Other Market Economy Countries	650	900	
U.S.S.R. e/	8,000	8,000	
World Total (may be rounded)	5/25,000	5/26,000	1,850,000

10. World Resources: World resources of arsenic trioxide, contain about 11 million tons of arsenic. Substantial resources of arsenic occur in copper ores in northern Peru and the Philippines, as well as in gold ores in Chile and Canada.

11. Substitutes: Substitutes for arsenic exist in most major end uses, although arsenic may be the preferred material due to lower cost and superior qualities. In agricultural uses, synthetic organic compounds such as paraquat may be substituted for arsenical pesticides, herbicides and desiccants. The wood preservatives, pentacholorophenol and creosote, may be substituted for chromated copper arsenate where odor and paintability are not a problem. Non-wood alternatives such as concrete and steel may be substituted for arsenical pressure treated wood. There are no available alternatives to the use of arsenicals as a growth regulator for grapefruit nor for some grape disease control.

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ASBESTOS

(Data in thousand metric tons, unless noted)

1. Domestic Production and Use: Three firms in California and Vermont produced all the domestic asbestos valued at $23 million in 1984. Manufacture of asbestos products by approximately 350 firms was centered in the Eastern States. Uses were friction products, 22%; flooring products, 21%; asbestos-cement pipe, 12%; coatings and compounds, 11%; asbestos-cement sheet, 8%; packing and gaskets, 6%; roofing products, 3%; paper and textiles, 1%; and other, 16%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production (sales): Mine	80	76	64	70	60
Imports for consumption	327	338	242	196	220
Exports	49	64	59	55	40
Shipments from Govt. stockpile excesses	-	-	-	-	-
Consumption, apparent	356	349	247	217	240
Price: Average value, dollars per ton, f.o.b. mine	382	406	392	399	404
Stocks: Consumer, yearend	84	85	85	79	80
Employment: Mine and mill e/	240	225	215	190	190
Net import reliance 1/ as a percent of apparent consumption 2/	78	78	74	68	75

3. Recycling: Insignificant.

4. Import Sources (1980-83): Canada 95%, Republic of South Africa 5%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Asbestos	518.11	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 10% (Foreign).

7. Government Stockpile:

Stockpile Status--11-30-84

Material (metric tons)	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Chrysotile				
stockpile grade	2,722	8,923	5,080	0
nonstockpile grade		830		0
Total		9,753	5,080	0
Amosite				
stockpile grade	15,422	30,854	0	0
nonstockpile grade		1	0	0
Total		30,855	0	0
Crocidolite	0	33	0	0

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ Stockpile grades of asbestos were available only from Zimbabwe in 1984.
3/ See page 180 for definitions.

Prepared by R. A. Clifton, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: Domestic demand for asbestos rose, for only the second time since 1978. The 1984 increase of 11%, however, left the market at only 30% of the 1973 high. Large mine surpluses still exist, and domestic production decreased 14%. Imports increased 12%. From a 1980 base, demand is expected to have no growth through 1990. It is estimated that in 1985 domestic mine production of asbestos will be 65,000 tons and U.S. apparent consumption 260,000 tons.

Shortages prior to 1980 and environmental problems may have resulted in permanent losses of U.S. market segments. High dependence on imports to satisfy demand for each grade and variety of asbestos continued in 1984. Canadian producers, some with corporate ties to U.S. firms, provided more than 92% of the total asbestos imported. Domestic users were totally dependent on the Republic of South Africa for crocidolite and amosite. Temporary mine closures were less common during the first 6 months of 1984 than in all of 1983 in most asbestos producing countries.

The promulgation of a Temporary Emergency Standard (TES) for occupational exposure to asbestos was halted by judicial action. The Occupational Safety and Health Administration, however, has progressed through the hearing stage on a permanent proposal that would reduce the permissible exposure level to 0.5 fibers per cubic centimeter of air, one-fourth of the present level.

The plans of the Office of Toxic Substances, Environmental Protection Agency, to propose a ban of asbestos use in cement pipe, roofing materials, and floor coverings, accompanied by gradual reduction of use in all other products, has not reached the hearing stage.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	70	60	4,000
Canada (shipments)	830	1,040	37,000
South Africa, Republic of	220	250	22,000
Other Market Economy Countries	780	850	13,000
Centrally Planned Economies	2,300	2,400	28,000
World Total (may be rounded)	4,200	4,600	104,000

10. World Resources: The world has 200 million tons of identified resources and an additional 45 million tons classified as hypothetical resources. The U.S. resources are large but are mostly short fibers.

11. Substitutes: Environmental considerations aside, no single material has met the following set of criteria that would make it a viable substitute for asbestos: 1. It must have the strength of asbestos, 2. It must have the chemical inertness of asbestos, 3. It must have the durability of asbestos, and 4. It must approach the economy of asbestos. The substitute coming closest to meeting these criteria is the chrysophosphate mentioned last year which uses asbestos as the basic raw material.

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BARITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Barite production in 1984 increased after 2 consecutive years of decline from the 1981 record high of 2.8 million tons valued at $102 million to 0.9 million tons valued at $32 million. The leading five companies supplied about 84% of the output. Production came from seven States, with 83% of the total from Nevada. Other leading States were Georgia and Missouri. About 2.9 million tons of ground barite from domestic production and imports was sold in 1984. Over 90% of the barite produced was used as a weighting agent in oil and gas well drilling fluids mostly in the gulf coast area. Barite was also used in paints, and rubber, and for producing barium chemicals and glass.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine 1/	2,245	2,849	1,845	754	900
Imports for consumption (crude barite)	1,850	1,932	2,320	1,396	1,600
Exports	97	62	49	23	2
Consumption, apparent (crude barite)	3,998	4,719	4,116	2,127	2,500
Consumption 2/ (ground and crushed)	3,649	4,716	4,088	2,745	2,900
Price: Average value, dollars per ton, mine	29.38	35.96	37.68	38.73	35.00
Stocks: Producer, yearend		Not available			
Employment: Mine and mill e/	2,050	2,150	1,500	1,000	1,000
Net import reliance 3/ as a percent of apparent consumption	44	40	55	65	64

3. Recycling: None.

4. Import Sources (1980-83): China 43%, Morocco 13%, Chile and Peru 12% each, Other 20%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude barite	472.10	$1.27/long ton	$1.27/long ton	$4.00/long ton
Ground barite	472.12	$3.25/long ton	$3.25/long ton	$7.50/long ton
Blanc fixe	472.14	0.2¢/lb	0.2¢/lb	1.25¢/lb

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Sold or used by producers.
2/ Domestic and imported crude barite sold or used by grinding establishments.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.

Prepared by S. G. Ampian, telephone number (202) 634-1180.

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8. Events, Trends, and Issues: Demand for barite in 1984 increased 18% after 2 consecutive years of decline from the record highs of recent years, owing to an overall improvement in the domestic economy. The sharp decline which had persisted from the latter half of 1982 until 1983 was due primarily to a continuing oil glut and economic downturn which resulted in lower oil- and gas-well-drilling activity. In 1984, primary producers of barite continued output at pre-1975 levels. Imports for consumption of cheaper foreign crude barite rose, after a decline in 1983, to pre-1980 levels; however, imports for the third consecutive year exceeded domestic production. Barite grinding capacity, escalated earlier to meet the higher demand, continued in a position to meet present and/or projected demand. From a 1983 base, barite demand is expected to increase at an average annual rate of under 2% through 1990. It is estimated that in 1985 domestic mine production will be 1.0 million tons and U.S. apparent consumption will be 3.0 million tons.

The U.S. International Trade Commission on Oct. 17, in response to a petition filed by the sole remaining domestic producer of barium chemicals alleging that imported Chinese barium carbonate and barium chloride were being sold at less than fair market value, ruled for the petitioner on barium chloride and imposed a 14.5% duty on imports. In another related event, ground Chinese drilling-mud-grade-barite imports, previously nil, were beginning to compete with domestically ground barite in the already depressed gulf coast area markets. Lastly, a large integrated domestic barite producer and grinder, with mines in Nevada and grinding facilities in Louisiana and Oklahoma ceased operations.

The low cost and technical advantages of barite preclude substitutes in the drilling mud market. Transportation costs, the availability of cheaper imports, and the growth rate of barite demand affect the development of domestic barite resources. The principal environmental impact of barite mining is the land disturbance normally associated with mining. Barite dust from grinding plants can be controlled satisfactorily by air pollution control equipment.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1983	1984 e/	
United States 1/	754	900	60,000
Canada	31	30	20,000
France	165	200	6,000
Germany, Federal Republic of	276	300	6,000
India	331	350	40,000
Ireland	240	250	9,000
Italy	165	170	6,000
Mexico	386	300	10,000
Morocco	303	310	4,000
Peru	180	200	8,000
Thailand	207	250	10,000
Other Market Economy Countries	1,294	1,400	22,000
China e/	1,100	1,200	20,000
U.S.S.R. e/	570	570	10,000
Yugoslavia	44	40	3,000
Other Centrally Planned Economies e/	300	320	10,000
World Total (may be rounded)	6,300	6,800	244,000

10. World Resources: In the United States, identified resources of barite are estimated to be 100 million tons, and the hypothetical resources include an additional 150 million tons. The world's barite resources in all categories are about 2 billion tons, but only about 400 million tons are identified.

11. Substitutes: In the drilling mud market, alternatives to barite include celestite, ilmenite, iron ores, and synthetic hematite manufactured in the Federal Republic of Germany. However, none of these substitutes has had major impact on the barite drilling mud industry.

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BAUXITE 1/

(Data in thousand metric dry tons, unless noted)

1. Domestic Production and Use: In 1984, bauxite shipments valued at $11.4 million were made from six surface mines located in Arkansas, Alabama, and Georgia. Five domestic companies operated the mines. Arkansas continued to be the major producer, even though a major mine and an alumina plant in the State were permanently closed. Of the remaining eight domestic alumina plants, only six were in operation during the year. About 90% of the domestic and imported bauxite consumed was processed into alumina, and primary aluminum smelters accounted for approximately 89% of the total alumina consumption. The refractory, abrasive, and chemical industries consumed the balance of the bauxite and the alumina not used for metal production.

2. Salient Statistics--United States 2/:

	1980	1981	1982	1983	1984 e/
Production: Mine	1,559	1,510	732	679	890
Imports of bauxite for consumption 3/4/	14,700	13,300	10,400	7,600	11,700
Imports of alumina	4,358	3,978	3,182	4,030	4,500
Exports of bauxite 4/	33	52	65	104	110
Exports of alumina	1,138	730	563	591	675
Shipments from Govt. stockpile excesses			None		
Consumption, apparent, bauxite and alumina 5/	5,283	5,039	3,672	3,798	4,560
Prices: Dollars per ton, f.o.b. mine	6-16	8-20	8-20	13-20	13-20
Stocks of bauxite: Industry, yearend	8,300	8,300	7,200	5,500	6,200
Employment: Mine	314	290	140	155	180
Net import reliance 6/ as a percent of apparent consumption	94	94	96	96	96

3. Recycling: None.

4. Import Sources (1980-83): Bauxite: Jamaica 37%, Guinea 36%, Suriname 8%, Other 19%.
Alumina: Australia 79%, Jamaica 11%, Suriname 7%, Other 3%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Bauxite	601.06	Free	Free	$1/long ton
Bauxite, calcined	521.17	Free	Free	$1/long ton
Alumina	417.12	Free	Free	$10/short ton

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: As a result of contract agreements made in late 1983 between the U.S. and Jamaican Governments, 2 million long dry tons (LDT) (2.032 million metric dry tons (MDT)) of metal-grade bauxite was scheduled to be acquired through cash purchase and barter for delivery to the National Stockpile in 1984 and 1985. Deliveries through November 30, 1984, totaled about 997,000 LDT (1 million MDT) of bauxite from Jamaica. Two other contracts were signed during the year for the acquisition of 75,000 long calcined tons of refractory-grade bauxite supplied from China and scheduled to be delivered to an Illinois stockpile site in 1984 and 1985.

e/ Estimated.
1/ See also Aluminum.
2/ Includes U.S. Virgin Islands.
3/ Includes abrasive grade consumed in Canada.
4/ Includes all forms of bauxite, expressed as dry equivalent weights.
5/ The sum of the aluminum equivalents of U.S. bauxite production and net import reliance.
6/ Defined as imports - exports + adjustments for Government and industry stock changes. (all in aluminum equivalents).
7/ See page 180 for definitions.

Prepared by L.H. Baumgardner, telephone number (202) 634-1081.

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Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Bauxite-abrasive grade	1,016	-	-	-
Bauxite-metal grade:				
Jamaica type	21,337	11,638	-	-
Suriname type	6,198	5,385	-	-
Bauxite-refractory grade, calcined	1,422	203	-	-

8. Events, Trends, and Issues: Average operating rates for domestic alumina plants increased from 40% in 1983 to about 60% in 1984, despite the fact that two plants were not in operation. Increased demand for primary aluminum brought about a rise of over 50% in bauxite imports, and alumina imports gained about 12% over 1983. Foreign mines supplied 93% of the bauxite consumed in 1984, and nearly 50% of the alumina supply was imported. Only one alumina plant used domestic bauxite and virtually all of the alumina produced was consumed in nonmetal uses.

It is estimated that in 1985 domestic bauxite production will be 950,000 tons, and U.S. apparent consumption of bauxite and alumina, expressed as metric tons, aluminum equivalent, will be 4.6 million tons. From a 1981 base, apparent demand for primary aluminaum and primary nonmetal supplies is expected to increase at an average annual rate of about 6.3% through 1990. Because of increasing metal imports and recycling of scrap metal, the growth rate for bauxite and alumina demand is expected to be substantially lower than the growth in demand for the metal.

During the past 3 years, the closure of bauxite mines in Haiti, the Dominican Republic, and the north coast of Jamaica, left one mine in Jamaica as the only producer of Caribbean ore for export.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 7/
	1983	1984 e/	
United States	679	890	40,000
Australia	24,500	25,000	4,600,000
Brazil	7,000	7,500	2,300,000
Greece	2,900	3,200	650,000
Guinea	11,080	12,000	5,900,000
Guyana	1,791	1,900	900,000
India	1,923	1,900	1,200,000
Jamaica	7,300	6,900	2,000,000
Suriname	1,750	1,700	600,000
Yugoslavia	3,500	3,600	400,000
Other Market Economy Countries	3,926	4,500	2,900,000
Hungary	2,917	2,900	300,000
U.S.S.R.	4,600	4,600	300,000
Other Centrally Planned Economies	2,150	2,200	200,000
World Total (may be rounded)	76,000	78,800	22,300,000

10. World Resources: Bauxite resources (reserves plus subeconomic and undiscovered deposits) are estimated at 40 to 50 billion tons. The resources in millions of tons are as follows: The United States, 300 to 325; Caribbean and Central American Region, 2,000 to 3,000; South America, 10,000 to 15,000; Europe, 3,000 to 4,000; Africa, 13,000 to 15,000; Asia, 6,000 to 8,000; and Oceania, 7,000 to 10,000. Domestic resources of bauxite are inadequate to meet long-term demand, but the United States and most other major aluminum producing countries have virtually inexhaustible subeconomic resources of aluminum in materials other than bauxite.

11. Substitutes: Although bauxite is the only raw material used in the production of alumina on a commercial scale in the United States, research on processes to produce alumina from nonbauxitic materials is continuing. Possible alternate domestic raw materials for making alumina include clays, anorthosite, alunite, coal wastes, and oil shales. Bauxite substitutes for abrasives made from bauxite include silicon carbide, aluminum-zirconium oxide, and diamonds.

January 1985

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BERYLLIUM

(Data in short tons of contained beryllium, unless noted)

1. Domestic Production and Use: Domestic beryllium mineral production in 1984 was greater than that of 1983. One company in Utah mined bertrandite and converted both bertrandite and imported and domestic beryl to beryllium hydroxide in Utah, and processed the hydroxide into metal, its alloys, and compounds at a plant in Ohio. The only other company in the industry, with a plant in Pennsylvania, bought imported beryl and produced beryllium alloys. Beryllium consumption of 330 tons was worth $140 million, based on the producer price for metal ingots, and was used as metal in nuclear reactors and aerospace applications, 40%; as an alloy and oxide in electrical equipment, 36%; as an alloy and oxide in electronic components, 17%; and as compounds and metal in other applications, 7%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	W	W	W	W	W
Imports for consumption	74	87	115	97	70
Exports	29	39	67	19	20
Shipments from Govt. stockpile excesses			None		
Consumption, apparent	321	303	150	279	330
Price, dollars:					
Domestic, metal, per pound	140	173	194	206	213
Imported ore, per s.t.u. (20 lbs) BeO	69	94	121	126	90
Stocks: Consumer, yearend	W	W	W	W	W
Employment:					
Mine, fulltime equivalent employees e/	25	25	25	25	25
Primary refineries e/	400	400	400	400	400
Net import reliance 1/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1980-83): China 40%, Brazil 37%, Republic of South Africa 5%, Switzerland 3%, Other 15%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrates	601.09	Free	Free	Free
Unwrought beryllium waste and scrap	628.05	8.5% ad val.	8.5% ad val.	25.0% ad val.
Beryllium, wrought	628.10	9.0% ad val.	9.0% ad val.	45.0% ad val.
Beryllium-copper Master alloy	612.20	7.2% ad val.	6.0% ad val.	28.0% ad val.
Beryllium oxide or carbonate	417.90	3.7% ad val.	3.7% ad val.	25.0% ad val.
Other beryllium compounds	417.92	4.0% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.
3/ Excluding U.S. and China production data.

Prepared by D. Kramer, telephone number (202) 634-1083.

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7. Government Stockpile: The General Services Administration awarded a contract to a domestic company to supply the National Defense Stockpile with 30 tons of beryllium metal for delivery yearend 1985. This award was made under an amendment to a September 1983 contract, which requires delivery of 30 tons of metal by December 12, 1984.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Beryl ore (11% BeO)	720	720	-	-
Beryllium-copper master alloy	316	295	-	-
Beryllium metal	400	229	-	-

8. Events, Trends, and Issues: The only known active facility available in market economy countries for converting beryllium ores to impure hydroxides is located near Delta, UT. During 1984, the plant operated at less than full capacity. It is estimated that in 1985 beryllium concentrate production will be about the same as that of 1984 and U.S. apparent consumption of oxide, alloy, and metal will be 330 tons. From a 1983 base, demand for beryllium is expected to remain virtually unchanged through 1990.

In 1984, the domestic beryllium producer introduced a new beryllium-copper alloy containing small amounts of cobalt for use in the electronic and electrical markets. In addition, the company announced plans to nearly double its manufacturing capacity for beryllium-copper strip by 1987. Plans for construction of a plant to reclaim beryllium and copper from waste materials also were announced. This plant is expected to be in operation by the end of 1985.

Beryllium dust and fines have been recognized as the cause of berylliosis, a chronic lung disease. Harmful effects are minimized by maintaining a clean workplace and requiring use of safety equipment.

9. World Mine Production and Reserve Base:

	Mine Production 1983	Mine Production 1984 e/	Reserve Base 2/
United States	W	W	The United States has very little beryl that can be economically handsorted from pegmatites. The Spor Mountain area, Utah, contains a large reserve base of bertrandite, which was being mined. Domestic deposits of bertrandite ores contain about 28,000 tons of beryllium. The world reserve base is not adequately delineated.
Brazil	35	35	
South Africa, Republic of	1	1	
Rwanda	3	3	
Other Market Economy Countries	5	5	
China	NA	NA	
Other Centrally Planned Economies	84	85	
World Total 3/	128	129	

10. World Resources: No quantitative information is available on foreign resources of beryllium-bearing minerals and rocks. The identified resources of beryllium in known domestic deposits are estimated at 80,000 tons of contained beryllium. These resources are sufficient to supply U.S. needs for established uses in the foreseeable future.

11. Substitutes: Because of the relatively high price of beryllium, uses are expected to continue principally in applications which require its light weight, high strength, high thermal conductivity, and neutron moderating and reflecting capability. Steel, titanium, or graphite composites may be substituted for beryllium metal, and phosphor bronze for beryllium-copper alloys, but with substantial loss of performance.

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BISMUTH

(Data in thousand pounds of bismuth content, unless noted)

1. Domestic Production and Use: All domestic production was derived from processing intermediate metallurgical products, such as lead bullion, which contain bismuth as a minor constituent. One company in Nebraska accounted for all domestic primary production. Consumption continued to be centered in the industrial belt of the northern and eastern United States. Fifty-six companies east of the Mississippi River accounted for 88% of the bismuth consumption. Based on an estimated average dealer price of $4.00 per pound, reported consumption was valued at $10.8 million. Bismuth was used in pharmaceuticals and chemicals, 48%; manufacturing of parts for machinery, 27%; primary metal industries, 23%; and other uses, 2%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Refinery	W	W	W	W	W
Imports for consumption	2,217	2,436	2,026	1,972	1,900
Exports 1/	129	79	53	306	150
Shipments from Govt. stockpile excesses			None		
Consumption, reported	2,289	2,393	1,876	2,285	2,700
Price: Domestic, producer 2/			Not Available		
Stocks, yearend: Consumer	674	509	542	577	530
Employment: Plant e/	40	40	30	30	30
Net import reliance 3/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1980-83): Peru 35%, Mexico 35%, United Kingdom 14%, Federal Republic of Germany 4%, Other 12%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Metal, unwrought	632.10	Free	Free	7.5% ad val.
Alloys	632.66	6.4% ad val.	5.5% ad val.	45.0% ad val.
Compounds	418.00 & 423.80	8.8% ad val.	7.0% ad val.	35.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status-11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Bismuth	2,200	2,081	-	-

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Includes bismuth, bismuth alloys, and waste and scrap.
2/ The only domestic primary producer stopped publishing its bismuth list price on October 1, 1980.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Most of reserve base is bismuth recoverable from lead ores.
5/ See page 180 for definitions.
6/ Excluding U.S. production.

Prepared by J. F. Carlin, Jr., telephone number (202) 634-1073.

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8. Events, Trends, and Issues: Primary production of bismuth in the United States remained about the same as that of 1983, as the single producing plant continued to operate well below its estimated capacity of 1.1 million pounds. Consumption of bismuth increased. It is estimated that in 1985 U.S. reported consumption of bismuth will be 2.7 million pounds.

From a 1978 base, demand for bismuth is expected to increase at an average annual rate of about 1.7% through 1990. Reliance on imports of metal was expected to continue.

The sole domestic primary bismuth producer did not publish a bismuth list price in 1984. Dealer prices increased sharply throughout the year from $1.80 to $6.70 per pound as production problems at mines in some major producing countries created shortages.

The steel industry continued to experiment with free-machining alloy bar steels that used bismuth as an additive. Research was conducted on bismuth usage as a smoke and fire retardant and in electronic applications.

9. World Mine Production and Reserve Base:

	Mine Production 1983	Mine Production 1984 e/	Reserve Base 4/5/
United States	W	W	30,000
Australia	3,310	3,200	58,000
Bolivia	10	-	35,000
Canada	440	400	20,000
Japan	1,260	1,200	127,000
Korea, Republic of	200	200	10,000
Mexico	1,320	1,000	31,000
Peru	1,350	1,000	28,000
Other Market Economy Countries	-	-	22,000
Centrally Planned Economies	1,040	1,100	47,000
World Total	6/8,930	6/8,100	408,000

10. World Resources: Bismuth in the United States will continue to be recovered as a byproduct from domestic and imported lead ores and concentrates. Other potential sources include byproduct recovery from molybdenum and tungsten ores, and ash from West Virginia coal. Bismuth is known to occur in lead deposits in the Appalachian Mountains from Maine to Virginia. Large unmeasured quantities of bismuth are also present in Mexico, Bolivia, Peru, Australia, China, North Korea, and the Republic of Korea.

11. Substitutes: Antibiotics, magnesia, and alumina can replace bismuth in pharmaceutical uses. Mica and fishscales are acceptable substitutes in cosmetics. Iron, phosphorus, and potassium can be used for bismuth as a catalyst for production of acrylonitrile. Tellurium can replace bismuth as a steel additive, and plastics can substitute for bismuth alloys in holding devices and jigs for some applications.

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BORON

(Data in thousand short tons of boria (B_2O_3), unless noted)

1. Domestic Production and Use: Domestic production of boron minerals, primarily sodium borates, by three companies was centered in southern California. The largest producer operated an open pit tincal and kernite (sodium borate) mine and plant. A second firm with two facilities using Searles Lake brines as raw material accounted for the remaining sodium borate output. The third firm produced colemanite (calcium borate) and ulexite/probertite (sodium-calcium borate) from an underground mine in Death Valley.

   Total production of boria contained in minerals and compounds in 1984 was estimated to be 647,000 tons valued at $452 million. Firms primarily in the North Central and Eastern States were the chief consumers. Principal uses for boron compounds consumed in the United States were in glass products. Colemanite was used principally in textile-grade glass fiber manufacture, and ulexite was used in glass fiber and cellulosic insulations.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production 1/	783	740	607	637	680
Imports for consumption: Colemanite	28	22	2	16	25
Ulexite	2	18	14	11	10
Boric acid	6	1	2	4	5
Exports, gross weight of boric acid and refined borates	372	274	262	263	260
Consumption, reported	384	373	266	341	345
Price, dollars per ton, granulated pentahydrate borax in bulk, f.o.b. mine	169	186	201	201	201
Stocks, yearend 2/		Not available			
Employment 3/	1,800	1,800	1,700	1,600	1,600
Net import reliance 4/ as a percent of apparent consumption		Net exporter			

3. Recycling: Insignificant.

4. Import Sources (1980-83): Boric acid: Turkey, 47%; France, 19%; Argentina, 14%; Mexico, 13%; Other, 7%.
   Colemanite: Turkey, 95%; Yugoslavia, 5%.
   Ulexite: Turkey, 100%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Boric acid	416.10	1.5% ad val.	1.5% ad val.	8.5% ad val.
Calcium borate, crude	418.12	Free	Free	Free
Mineral articles and substances (ulexite)	523.81	Free	Free	Free

6. Depletion Allowance: Borax 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Minerals and compounds sold or used by producers, including both actual mine production and a marketable ore equivalent of brine products.
2/ Stocks data are not available and are assumed to be zero for net import reliance and apparent consumption calculations.
3/ Includes an estimated 200 to 500 in mines and 1,000 to 1,300 in plants.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.
6/ Gross weight of ore in short tons.
7/ Less than 1/2 unit.

Prepared by P. A. Lyday, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: A U.S. company patented a process to solution mine colemanite. The process produced boric acid using solar energy rather than costly hydrocarbon fuels. The company sought joint venture partners for a pilot plant in California.

A joint venture proposal was signed between the Government of Chile and a U.S. company to extract potassium and lithium salts, and boric acid at Salar de Atacama.

Several U.S. companies presented proposals to the Government of Bolivia to explore and develop Salar de Uyuni. The brine deposit contains high quantities of potassium, lithium, and boron in a form similar to that in the Salar de Atacama in Chile.

The Turkish Government began production in a plant at Kirka to produce pentahydrate borax. Production of anhydrous borax was to begin later in the year.

Boron and rare-earth magnets used in motors replaced conventional samarium and cobalt magnets in a revolutionary gearless motor. The motor was introduced to make a robot operate faster, more accurately, and more reliably than competitor robots.

From a 1983 base, demand for boron is expected to increase at an average annual rate of about 3.2% through 1990. It is estimated that in 1985 domestic mine production of boron will be 660,000 tons and U.S. apparent consumption will be 350,000 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/
	1983	1984 e/	Quantity 6/
United States 1/	637	680	230,000
Argentina	31	30	10,000
Bolivia	–	–	21,000
Chile	7/	7/	45,000
Peru	3	3	24,000
Turkey	365	370	160,000
China	6	10	40,000
U.S.S.R.	44	44	150,000
World Total (may be rounded)	1,090	1,140	680,000

10. World Resources: Large domestic resources of borate materials occur in California, chiefly in sediments and their contained brines. Extensive resources also occur in Turkey. World resources are adequate to supply needs at current rates for the foreseeable future.

11. Substitutes: Substitution for borates is possible in such applications as soaps, detergents, enamel, agriculture, and insulation.

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BROMINE

(Data in million pounds of bromine content, unless noted)

1. Domestic Production and Use: The estimated value of elemental bromine sold or used by domestic producers in 1984 was $97 million. Five companies operated nine bromine-producing plants in Arkansas and Michigan. Three of the companies produced about 99% of the output. No byproducts were obtained from Arkansas brines, but iodine, magnesium compounds, and calcium chloride, in addition to bromine, were produced from Michigan brines.

   Of the bromine compounds sold by U.S. producers, about 24% was used in the manufacture of the gasoline additive ethylene dibromide, about 35% was used in the manufacture of flame retardants, about 15% was for the production of oil and gas drilling and completion fluids, about 10% was sold as methyl bromine, and about 16% was used in other bromine compounds.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production 1/	378	377	401	370	340
Imports for consumption, elemental bromine and compounds	1	1	4	5	6
Exports, elemental bromine and compounds	79	2/56	2/47	2/56	2/50
Consumption, apparent	298	326	363	319	296
Price, cents per pound, bulk purified bromine	26.5-28.0	26.5-28.0	31.0-32.5	33.0-34.5	33.0-34.5
Stocks, producer, yearend, elemental bromine e/	9	5	--	--	--
Employment, plants	460	410	410	410	400
Net import reliance 3/ as a percent of apparent consumption	Net exporter				

3. Recycling: Approximately 2% of the U.S. bromine production was converted to byproduct sodium bromide solutions which were recycled to obtain elemental bromine.

4. Import Sources (1980-83): Israel 85%, United Kingdom 7%, France 7%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Bromine	415.05	2.8¢/lb	2.0¢/lb	10¢/lb
Ammonium bromide	417.44	3.3% ad val.	3.1% ad val.	25% ad val.
Ethylene dibromide	429.28	0.8¢/lb + 4.1% ad val.	0.7¢/lb + 3.5% ad val.	6.0¢/lb + 30% ad val.
Hydrobromic acid	416.45	4.7% ad val.	4.2% ad val.	25% ad val.
Potassium bromate	420.36	3.3% ad val.	3.1% ad val.	25% ad val.
Potassium bromide	420.02	1.6¢/lb	1.5¢/lb	10¢/lb
Methyl bromide	429.48	4.0% ad. val.	3.7% ad. val.	25% ad val.
Sodium bromide	420.82	4.2¢/lb	3.0¢/lb	10¢/lb

6. Depletion Allowance: 5% on brine wells (Domestic and Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Sold or used by U.S. producers.
2/ Compounds only.
3/ Define as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.
5/ From waste bitterns associated with solar salt.
6/ From the Dead Sea.
7/ Excluding countries for which no data are given.

Prepared by P. A. Lyday, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: Congress proposed a bill to authorize a United States-Israeli free-trade area to promote trade between the two countries by lifting all tariffs. The U.S. Bromine Alliance had requested that bromine be excluded from the agreement. The U.S. Trade Representative did agree to a 3-year moratorium on including bromine products in the agreement.

The U.S. Bromine Alliance submitted 13 petitions to the U.S. International Trade Commission (ITC) to modify the eligibility of brominated compounds for purposes of the U.S. Generalized System of Preferences (GSP). The Alliance suggested that many of the compounds would not be eligible for GSP if they were not included in categories that hid the magnitude of the imports.

Bromine is used as a scavenger for lead in leaded gasoline. The Environmental Protection Agency (EPA) proposed to decrease the use of lead alkyl compounds as octane-boosters by 91% effective January 1, 1986. The new regulation would make leaded gasoline more expensive than unleaded gasoline, resulting in a decreased demand for bromine.

The Federal Trade Commission finalized a consent order for the purchase of a bromine producer by another large bromine producer. Included in the consent were provisions for licensing brominated flame retardent technology acquired through the acquisition of a third company.

A major producer of bromine and brominated compounds announced plans to discontinue production at one plant in Michigan. Domestic supplies are not expected to be adversely affected.

It is estimated that in 1985 domestic production of bromine will be 320 million pounds and U.S. apparent consumption will be about 300 million pounds. From a 1983 base, demand for bromine is expected to increase at an average annual rate of about 1% through 1990.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1983	1984 e/	
United States 1/	370.0	340.0	1,000
Australia	NA	NA	5/
France	22.0	20.0	3,500
Germany, Federal Republic of	6.7	7.0	600
India	.8	.9	5/
Israel	154.0	220.0	6/
Italy	1.1	1.0	5/
Japan	26.5	26.0	1,800
Spain	.7	.8	5/
United Kingdom	64.0	60.0	5/
Other Market Economy Countries	2.0	2.0	NA
China	NA	NA	NA
U.S.S.R.	150.0	150.0	3,000
World Total (may be rounded) 7/	800.0	800.0	NA

10. World Resources: Resources of bromine are virtually unlimited. The Dead Sea in the Middle East is estimated to contain 1 billion tons of bromine. Seawater contains about 65 parts per million of bromine or an estimated 100 trillion tons. The bromine content of underground water in Poland has been estimated at 36 million tons.

11. Substitutes: Chlorine and iodine may be substituted for bromine in a few chemical reactions and for sanitation purposes. Aniline and some of its derivatives, methanol, ethanol, and gasoline-grade tertiary butyl alcohol are effective nonlead substitutes for ethylene dibromide and lead in gasoline. There are no substitutes for bromine in various oil and gas well completion and packer applications. Antimony oxide, alumina, organic chlorine compounds, and phosphorus compounds can be substituted for bromine as fire retardants for some uses.

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CADMIUM

(Data in metric tons of cadmium content, unless noted)

1. Domestic Production and Use: Cadmium was recovered as a byproduct of smelting domestic and imported zinc concentrates. Domestic refinery output, valued at $5.6 million, was produced by four companies operating five plants. The estimated consumption pattern was coating and plating, 35%; batteries, 25%; pigments, 20%; plastics and synthetic products, 15%; and alloys and other uses, 5%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Refinery	1,578	1,603	1,007	1,052	1,500
Imports for consumption: Metal	2,617	3,090	2,305	2,196	2,100
Flue dust	-	-	11	-	-
Exports: All forms	236	239	11	170	100
Shipments, from Govt. stockpile excesses			None		
Consumption, apparent	3,534	4,378	3,728	3,763	3,400
Price: Dollars per pound, producer, in 1 to 5 short ton lots, average	2.84	1.93	1.11	1.13	1.70
Stocks: Yearend, producer and consumer	1,768	1,844	1,417	732	850
Employment e/: Smelter and refinery	330	300	250	250	250
Net import reliance 1/ as a percent of apparent consumption	55	63	73	72	56

3. Recycling: Cadmium usage was largely dissipative. Recycling has been practical only for nickel-cadmium batteries and some alloys and industrial wastes.

4. Import Sources (1980-83): Metal--Canada 29%, Australia 24%, Mexico 8%, Peru 8%, Other 31%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Flue dust	603.20	Free	Free	Free
Metal	632.14	Free	Free	15¢/lb

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Cadmium	5,307	2,871	-	-

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.

Prepared by P. A. Plunkert, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: Domestic cadmium refinery production fell short of satisfying domestic demand, but imports of metal and stock withdrawals made up the shortfall. Of the various applications for cadmium, the usage of cadmium in nickel-cadmium batteries probably has the highest growth potential. Research has provided some potential new uses for cadmium sulfide and cadmium telluride in solar photovoltaic cells. It is estimated that in 1985 domestic refinery production of cadmium will be 1,500 tons and U.S. apparent consumption will be 3,700 tons. From a 1978 base, demand for cadmium is expected to increase at an average annual rate of 1.8% through 1990.

The domestic producer price of cadmium at the beginning of 1984 was quoted at $1.25 per pound. The price quotes increased to a high of $2.25 per pound during the second quarter and by November producers listed a price of $1.55 per pound. Dealer prices which began the year at $0.90 to $0.95 per pound fluctuated during the year. By November, the dealer price was $1.15 to $1.20 per pound. Although quoted producer prices have tended historically to be higher than dealer prices, both prices have followed the same general trends.

Concern over the dispersal of toxic materials has had the dual effect of increasing cadmium recovery at primary smelters and reducing the amount of cadmium dissipated in the environment through industrial operations.

9. World Refinery Production and Reserve Base:

	Refinery Production		Reserve Base 2/
	1983	1984 e/	
United States	1,052	1,500	160,000
Australia	1,000	1,000	85,000
Belgium	1,100	1,100	-
Canada	1,107	1,100	170,000
Japan	2,200	2,200	15,000
Mexico	900	900	25,000
Other Market Economy Countries	5,619	5,600	295,000
Centrally Planned Economies	4,266	4,200	90,000
World Total	17,244	17,600	840,000

10. World Resources: World resources of cadmium are estimated at about 9 million tons. Because of the geochemical association of zinc and cadmium, resources of cadmium are estimated to be 0.5% of zinc resources. Large potential resources of cadmium are contained in the zinc-bearing coals of mid-continent United States and perhaps in Carboniferous-age coals of other countries. Undiscovered cadmium resources are estimated to be 5 million to 50 million tons of content depending on the ore-occurrence model used.

11. Substitutes: Coatings of zinc or vapor deposited aluminum can be substituted for some cadmium plating applications. Plastic stabilizers formulated with tin may be used in place of cadmium compounds. Zinc and iron pigments can be used in place of cadmium pigments but often at the risk of reduced performance.

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CEMENT

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: One State agency and 47 companies operated 143 plants in 40 States to produce 75 million tons of portland cement, 3 million tons of masonry cement, and minor quantities of calcium aluminate cement in 1984. The value of this production was $4.0 billion. By yearend, the capacity of 131 plants producing portland cement clinker, including 3 white cement facilities, was 273,000 tons per day. Allowing for an average of 44 days downtime per year for maintenance and rebricking kilns, the apparent annual clinker production capacity was 87 million tons. An additional 12 plants operated grinding mills only for imported, purchased, or interplant transfers of clinker. Estimated finish-grinding capacity was 104 million tons. The 5 largest companies comprised 37% of the clinker production capacity; the 10 largest accounted for 55%; and the 20 largest had 78% of the capacity. Fifty percent of the portland cement production came from six States: Texas, California, Pennsylvania, Missouri, Michigan, and Florida, in declining order. Uses for domestic cement were 69% for ready-mixed concrete; 12% for concrete products such as block, pipe, and prestressed precast concrete; 6% by building material dealers; 4% by highway contractors; and 9% by other contractors, government agencies, and miscellaneous.

2. Salient Statistics--United States: 1/

	1980	1981	1982	1983	1984
Production (portland, masonry, and other)	75,224	71,710	63,355	70,420	78,000
Shipments from mills (includes masonry cement)	76,242	71,748	64,066	70,934	81,000
Imports for consumption	5,244	3,963	2,911	4,221	8,000
Exports	186	300	201	118	80
Consumption, apparent 2/	77,599	73,321	65,623	74,565	86,000
Average mill value, dollars per ton	50.98	51.89	50.94	49.95	51.02
Stocks: Mill, yearend	6,825	7,372	6,753	6,711	6,500
Employment: Mine and mill e/	24,200	22,000	20,000	20,000	20,000
Net import reliance 3/ as a percent of apparent consumption	6	4	5	6	9

3. Recycling: None.

4. Import Sources (1980-83): Canada 56%, Spain 11%, Mexico 8%, Japan 8%, Other 17%.

5. Tariff: 4/

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
White nonstaining portland cement	511.11	1¢/100 lb	1¢/100 lb	8¢/100 lb
Other hydraulic cement and clinker	511.14	Free	Free	6¢/100 lb

6. Depletion Allowance: Certain raw materials for cement production such as limestone, bauxite, and gypsum have depletion allowances.

7. Government Stockpile: None.

e/ Estimated.
1/ Excludes Puerto Rico.
2/ Adjusted to eliminate duplication of imports shipped by domestic cement manufacturers.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Rates include weight of container.

Prepared by Wilton Johnson, telephone number (202) 634-1184.

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8. Events, Trends, and Issues: Total U.S. demand increased about 17% above that of 1983. The increase was due primarily to improved industrial, commercial, and residential construction activity. Finished portland cement production capacity utilization increased to 73% compared with 64% in 1983. Utilization of clinker production capacity increased to 88% compared with 73% in 1983. Cement consumption increased in all regions of the country with the Pacific and South Atlantic regions experiencing the biggest increases, 25% and 16%, respectively. Increases experienced by other regions were: East North Central, 15%; New England, 14%; East South Central, 14%, Middle Atlantic, 12%; Mountain, 7%; West South Central, 11%; and West North Central, 9%. From a 1983 base, demand for cement is expected to increase at an average annual rate of 2.0% through 1990. It is estimated that in 1985 domestic production of cement will be 83 million tons and U.S. apparent consumption will be 87 million tons.

The gap between domestic production and demand continued to widen as the industry relied more heavily on imports to meet its cement requirements. Import reliance as a percent of apparent consumption reached 9%, its highest level since 1979.

The trend continued toward consolidation of the industry through acquisition of companies and plants by larger firms, most of which were foreign owned. By yearend approximately 35% of cement production capacity was foreign owned. To increase efficiency and economy of energy use, cement producers continued to incorporate preheaters, some with flash calciners, and dry-process kilns into plant modernization programs, and to convert to coal and coke as kiln fuel.

Environmental concerns have promoted the use of dust collectors and electrostatic precipitators to control atmospheric emissions of particulates. Air pollution control equipment has become a major cost item in cement plant construction, renovation, and maintenance.

9. World Production and Capacity:

	Production		Yearend Clinker Capacity	
	1983	1984 e/	1983	1984 e/
United States (includes Puerto Rico)	71,350	79,000	89,000	90,000
France	27,000	28,000	30,000	30,000
Germany, Federal Republic of	34,000	36,000	45,000	46,000
Italy	43,230	45,000	55,000	55,000
Japan	88,900	90,000	132,000	132,000
Spain (includes Canary Islands)	33,800	34,000	39,000	39,000
United Kingdom	14,800	15,000	20,000	20,000
Other Market Economy Countries	361,640	362,000	464,000	506,000
China	119,330	120,000	132,000	132,000
U.S.S.R.	141,100	142,000	154,000	154,000
Other Centrally Planned Economies	85,200	95,000	108,000	108,000
World Total	1,020,350	1,046,000	1,268,000	1,312,000

10. World Resources: Although domestic resources of raw materials are adequate, they are sometimes remote from cement market areas. Countries deficient in one or more raw materials have experienced little difficulty importing their requirements.

11. Substitutes: Aluminum, steel, fiberglass, wood, stone, and clay products may be used in the building and construction markets.

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CESIUM

(Data in pounds of cesium content, unless noted)

1. Domestic Production and Use: Cesium was not mined in the United States in 1984. One firm in Pennsylvania imported pollucite, the principal commercial ore of cesium, and accounted for all of the domestic output of cesium products. Cesium, usually in the form of chemical compounds, was used mainly in research and development, including the development of magnetohydrodynamic (MHD) electric power generators, thermionic energy converters, and biological research. Cesium was used commercially in electronic, photoelectric and medical applications.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine			None		
Metal and compounds	W	W	W	W	W
Imports for consumption:					
Pollucite and metal			Not available		
Cesium compounds including cesium chloride, gross weight	11,800	24,000	17,000	19,000	48,000
Exports			Not available		
Consumption, apparent:					
Metal and compounds			Not available		
Demand e/ estimated:					
Metal and compounds	19,000	21,000	21,000	26,000	42,000
Price, dollars					
Pollucite, per short ton	400	400	350-400	350-400	350-400
Metal, per pound	275-325	275-325	275	275-325	275-325
Cesium oxide, per pound	NA	NA	400	400	400
Cesium compounds, per pound	29-37	29-37	32-41	32-80	32-80
Stocks, producer, yearend	W	W	W	W	W
Employment: Plant e/	25	25	25	25	25
Net import reliance 1/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1980-83): Pollucite: Canada 100%.
Compounds, including cesium chloride: Federal Republic of Germany 94%, Other 6%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	601.66	Free	Free	Free
Cesium	415.10	6.1% ad val.	5.3% ad val.	25.0% ad val.
Cesium chloride	418.50	4.5% ad val.	4.0% ad val.	25.0% ad val.
Other compounds	418.52	4.3% ad val.	4.0% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.

Prepared by W. Timothy Adams, telephone number (202) 634-1082.

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8. Events, Trends, and Issues: Preliminary data indicate that U.S. demand for cesium in 1984 was 62% higher than that in 1983. From a 1983 base, demand for cesium is expected to increase at an average annual rate of about 3.2% through 1990. However, requirements for research may cause significant changes in demand from year to year as occurred in 1984.

   The United States obtains cesium ore and a large part of its manufactured cesium compounds from foreign sources. Future cesium supplies will be dependent upon foreign sources unless domestic deposits are discovered or technology is developed to use low-grade raw materials.

   The high cost and extreme reactivity of cesium limit its applications.

   No significant environmental problems have resulted from the production of cesium products because of the small scale of production.

9. World Mine Production and Reserve Base: Data on mine production of cesium are not available. Cesium forms independent minerals in pegmatites and is commonly obtained as a coproduct in the processing of titanium, beryllium, or lithium minerals. The reserve base 2/ is mainly associated with the cesium silicate mineral, pollucite, which contains about 20% cesium, and is located in Canada, 80,000 short tons of contained cesium, Zimbabwe, 25,000 tons, and Namibia, 10,000 tons. The reserve base appears to be sufficient for many years, provided the rate of growth in demand for cesium does not increase significantly.

10. World Resources: World resources of cesium are not known, but probably could be increased substantially by intensive exploration.

11. Substitutes: Rubidium can replace cesium in many uses. Certain other elements can be substituted in light-sensing equipment, and potassium may be used instead of cesium in MHD power generation.

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CHROMIUM

(Data in thousand short tons, gross weight, unless noted)

1. Domestic Production and Use: The United States continued to be one of the world's leading consumers of chromium. Chromite was consumed by four firms producing chromium ferroalloys and metal, seven firms producing refractories, and three firms producing chromium chemicals. Most of these were in the Eastern United States. Of the chromite consumed, the chemical and metallurgical industry used 79% and the refractory industry 21%. Consumption of chromium ferroalloys, metal, and other chromium-containing materials by end use was as follows: Stainless and heat-resisting steel, 81%; full-alloy steel, 9%; superalloys, 3%; and other alloys, 7%. The total value of chromium consumed as chromite and ferrochromium was estimated to be $112 million.

2. Salient Statistics--United States: 1/

	1980	1981	1982	1983	1984 e/
Production: Chromite			None		
Imports for consumption	461	508	239	231	389
Exports	40	52	10	13	9
Consumption: Reported	358	349	232	301	390
Apparent 2/	587	510	319	329	466
Price, chromite, yearend:					
Turkish, dollars per metric ton, Turkey	110	110	110	110	110
South African, dollars per metric ton, South Africa	55	55	52	52	52
Consumer stocks, yearend	250	251	209	175	151
Net import reliance 3/ as a percent of apparent consumption	91	90	85	76	82

3. Recycling: In 1984, estimated chromium contained in purchased stainless steel scrap amounted to 18% of chromium demand.

4. Import Sources (1980-83): Chromium contained in chromite and ferrochromium: Republic of South Africa, 55%; Zimbabwe, 8%; U.S.S.R., 7%; Philippines, 6%; Other, 24%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	601.15	Free	Free	Free
Low-carbon ferrochromium	606.22	3.4% ad val.	3.1% ad val.	30% ad val.
High-carbon ferrochromium	606.24	1.9% ad val.	No target duty	7.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: About 125,000 tons of chromite in the stockpile were converted to high-carbon ferrochromium for the General Services Administration (GSA). The GSA also solicited bids in 1984 to convert an additional 142,000 tons of chromite to high-carbon ferrochromium in 1985.

e/ Estimated.
1/ Data in thousand short tons of contained chromium.
2/ Calculated total demand for chromium.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.

Prepared by J. F. Papp, telephone (202) 634-1028.

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Stockpile Status--11-30-84

Material	Goal	Total Inventory	Average Chromium Content	Excess to Goal Authorized For Disposal	Sales, 11 Months
Chromite:					
Metallurgical-grade	3,200	1,957	28.6%	-	-
Chemical-grade	675	242	28.6%	-	-
Refractory-grade	850	391	-	-	-
Chromium ferroalloys:					
High-carbon ferrochromium	185	402	71.4%	-	-
Low-carbon ferrochromium	75	300	71.4%	-	-
Ferrochromium-silicon	90	57	42.9%	-	-
Chromium metal	20	4	-	-	-

In addition to data shown, the stockpile contained the following nonstockpile-grade materials: 531,219 tons of metallurgical-grade chromite and 20,762 tons of chromium ferroalloys.

8. Events, Trends and Issues: After 3 consecutive years of decline, demand for chromium increased in 1983 and increased again in 1984. These increases reflect increased demand in the steel industry, the major consumer of chromium. Compared with that of 1983, reported chromium consumption increased by 30%.

The published price of Turkish high-chromium chromite remained at $110 per metric ton, and South African high-iron chromite price remained at $48-$52 per metric ton. The price of chromium metal, $3.75 to $4.40 per pound, remained unchanged through 1984.

From a 1983 base, demand for primary chromium is expected to increase at an average annual rate of about 6.5% through 1990. It is estimated that in 1985 domestic mine production of chromite will be zero, and U.S. apparent consumption of chromium will be about 450,000 tons.

9. World Chromite Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/ (shipping grade)
	1983	1984 e/	
United States	-	-	-
Brazil	310	350	10,000
Finland	375	400	32,000
India	400	450	66,000
Philippines	365	400	32,000
South Africa, Republic of	2,460	2,500	6,300,000
Turkey	440	450	80,000
Zimbabwe	475	500	830,000
Other Market Economies	351	400	25,000
Albania	990	1,000	22,000
U.S.S.R.	2,700	2,700	142,000
Other Centrally Planned Economies	55	60	4,000
World Total (may be rounded)	8,921	9,210	7,540,000

10. World Resources: World resources total about 36 billion tons of shipping-grade chromite, sufficient to meet conceivable demand for centuries. Over 99% of these resources are in southern Africa, nearly 26 billion tons in the Republic of South Africa, and over 11 billion tons in Zimbabwe. Although the rest of the world's resources are measured in millions of tons, they are small in comparison with those of Africa. Most of the U.S. chromium resources are in the Stillwater Complex in Montana and beach sands of Oregon. Domestic chromite mining in the near future is doubtful.

11. Substitutes: Substitution possibilities for chromium include: Nickel for plating, iron for pigments, and boron for alloying. Magnesite may substitute for chromite in refractories.

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CLAYS

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1984 clays were produced in all States except Alaska, Delaware, Hawaii, Rhode Island, Vermont, and Wisconsin. The leading 35 firms supplied about one-half of the output and over 300 firms the remainder. Together these firms operated about 1,100 mines. Estimated value of all marketable clay produced was a record high of $1.1 billion. In 1984 major domestic uses for specific clays were estimated as follows: Kaolin--46% paper, 7% refractories, 4% rubber; ball clay--32% dinnerware and pottery, 13% floor and wall tile, 18% sanitaryware; fire clay--47% firebricks, 6% foundry sands; bentonite--40% drilling mud, 20% foundry sand bond; 10% iron ore pelletizing; fuller's earth--66% absorbent and filtering uses, 8% insecticide dispersant; and common clay--96% construction materials.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Mine production:					
Kaolin	7,879	7,660	6,362	7,203	7,800
Ball clay	894	845	642	747	850
Fire clay 1/	2,095	1,927	1,087	1,043	1,250
Bentonite	4,185	4,947	3,245	2,887	3,500
Fuller's earth	1,534	1,656	1,683	1,912	2,100
Common clay	32,204	27,543	22,326	27,066	28,500
Total	48,791	44,579	35,345	40,858	44,000
Imports for consumption	34	33	24	21	30
Exports	3,214	3,151	2,619	2,484	2,700
Consumption, apparent	45,611	41,461	32,750	38,395	41,330
Price	$2 to $300 per ton, depending on type and quality				
Stocks, yearend	Not available				
Employment e/: Mine	2,800	2,400	2,000	2,000	2,100
Mill	12,000	10,000	9,500	9,000	9,500
Net import reliance 2/ as a percent of apparent consumption	Net exporter				

3. Recycling: Insignificant.

4. Import Sources (1980-83): United Kingdom 65%, Canada 19%, Federal Republic of Germany and Mexico, 7% each, and Other 2%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
China clay and kaolin 3/	521.41	33¢	33¢	$2.50
Fuller's earth, not beneficiated 3/	521.51	25¢	25¢	$1.50
Wholly or partly beneficiated 3/	521.54	50¢	50¢	$3.25
Bentonite 3/	521.61	40¢	40¢	$3.25
Ball clays, not beneficiated 3/	521.71	39¢	38¢	$1.00
Wholly or partly beneficiated 3/	521.74	79¢	77¢	$2.00
Other clays, not beneficiated 3/	521.81	Free	Free	$1.00
Wholly or partly beneficiated 3/	521.84	50¢	50¢	$2.00
Artificially activated clays	521.87	0.01¢/lb + 3.4% ad val.	2.5% ad val.	0.25¢/lb + 30% ad val.

6. Depletion Allowance: Kaolin, ball clay, bentonite, fuller's earth, and fire clay 14% (Domestic), 14% (Foreign); clay used for extraction of alumina or aluminum compounds, 22% (Domestic); clay and shale used for making brick, tile, and lightweight aggregate 7.5% (Domestic), 7.5% (Foreign); clay used in making drainage and roofing tile, flower pots, and kindred products, 5% (Domestic), 5% (Foreign).

e/ Estimated.
1/ Refractory uses only.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Per long ton.

Prepared by S. G. Ampian, telephone number (202) 634-1180.

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7. Government Stockpile: None.

8. Events, Trends, and Issues: Total clays sold or used by domestic producers in 1984 increased 7% in tonnage and rose 24% in value. This increase in production, for the second consecutive year, continues to reverse the downward trend in total clay production that had persisted from 1978 to 1982. The clay producers, responding to an overall strengthening of the economy, operated between 60% to 90% of capacity during the year. Exports for the first time since 1980, in spite of the strong U.S. dollar, reversed the downward slide in U.S. clay exports by increasing shipments nearly 10% over that exported in 1983; however, exports were still at pre-1979 levels. From a 1983 base, demand for individual types of clays is expected to increase at an average annual rate of 2% to 4% through 1990. It is estimated that in 1985 domestic mine production of clays will be 45 million tons and U.S. apparent consumption will be 42 million tons. The continued growth of the energy intensive clay-based industries could be slowed again by the return of higher energy costs and lower construction rates. Average prices for most clays are expected to rise slowly, reflecting higher quality requirements for the specialty clays and increasing costs associated with land acquisition, land rehabilitation, and environmental and energy factors. Greater recovery of byproducts and coproducts should occur as processing technology improves and as problems of solid waste disposal become increasingly acute.

   Further enhancement of the U.S. position as a major world supplier of high-quality clays is assured by the possession of more than adequate resources of all major types of clay coupled with the clay processing technology necessary to provide large quantities of consistent-quality clays over extended periods.

9. World Mine Production and Reserve Base: Not available.

10. World Resources: Clays are divided for commercial purposes into kaolin, ball clay, fire clay, bentonite, fuller's earth, and common clay. Resources of these types of clay are extremely large, except for lesser resources of high-grade ball clay, fire clay, and sodium-bentonite. Resources of kaolin in Georgia are estimated to be 5 to 10 billion tons.

11. Substitutes: Limited substitutes and alternatives, such as talc and whiting, are available for filler and extender applications.

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COBALT

(Data in short tons of cobalt content, unless noted)

1. Domestic Production and Use: Domestic mine production ceased at the end of 1971. Most secondary cobalt is derived from recycled superalloy or cemented carbide scrap and from spent catalysts. One foreign company operated a plant, located in Laurinburg, North Carolina, to produce extra fine cobalt powder. The single domestic refiner of cobalt was located in Louisiana. About 15 processors were active in the production of cobalt compounds in 1984. Industrial consumers totaled about 225, with the largest in Michigan, Pennsylvania, Indiana, and New Jersey. Cobalt consumption increased for the second consecutive year after a 4-year decline. Superalloys, mainly for industrial and aircraft gas turbine engines, accounted for about 34% of reported consumption; magnetic materials for various electrical applications, 19%; driers, 10%; catalysts, 10%; metal cutting and mining tool bits, 6%; and other, 21%. Total estimated value of cobalt consumed in 1984 was $170 million.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine			N O N E		
Secondary	592	486	436	362	450
Imports for consumption	8,151	7,797	6,435	8,611	12,500
Exports e/	292	417	300	412	390
Shipments from Govt. stockpile excesses	-	1/(1,165)	1/(1,435)	1/(132)	1/(3,250)
Consumption: Reported	7,661	5,840	4,734	5,660	8,500
Apparent	8,527	6,266	5,592	7,856	9,250
Price, producer for cathodes, range, dollars per pound	25.00	17.26-25.00	12.50-17.26	12.50	12.50
Stocks: Industry, yearend	3,753	4,188	3,733	4,305	4,360
Employment: Mine			N O N E		
Net import reliance 2/ as a percent of apparent consumption	93	92	92	95	95

3. Recycling: About 450 tons of cobalt was recycled from purchased scrap in 1984. This represented about 5% of estimated reported consumption for the year.

4. Import Sources (1980-1983): Zaire 37%, Zambia 12%, Canada 10%, Japan 7%, Other 34%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	601.18	Free	Free	Free
Unwrought metal, waste and scrap	632.20	Free	Free	Free
Alloys, unwrought	632.86	9% ad val.	9% ad val.	45% ad val.
Chemical compounds:				
Oxide	418.60	1.2¢/lb.	1.2¢/lb.	20¢/lb.
Sulfate	418.62	1.4% ad val.	1.4% ad val.	6.5% ad val.
Other	418.68	5.1% ad val.	4.2% ad val.	30% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: The General Services Administration (GSA) awarded a contract to a Canadian company for the purchase of 250 tons of cobalt for the National Defense Stockpile. The contract specified that the cobalt was to be delivered within a year of the purchase, September 26, 1984. The purchase price was $11.70 per pound of electrolytic cobalt. This acquisition, in addition to 3,250 tons of cobalt purchased in 1983 but not yet recorded as inventory, will bring GSA's cobalt inventory up to 62% of the 42,700 ton goal.

e/ Estimated.
1/ Data in parentheses denote stockpile acquisitions.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.

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Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months	Purchases, 11 Months
Cobalt	42,700	23,097	-	-	250

8. Events, Trends, and Issues: Demand for cobalt rose for the second consecutive year in 1984. Domestic consumption increased markedly in the manufacture of tungsten carbide and magnets and moderately in welding materials and catalysts. The U.S. spot price for cobalt began the year at $6.10 per pound, and rose gradually to $7.10 per pound by March 1, when it leaped to $11.80 per pound in the period of a week. The sudden price increase was attributed to a temporary supply dislocation. The price remained near $11.00 per pound for most of the rest of the year.

Surplus market conditions are expected to prevail worldwide in 1985 because supply has continued to exceed demand. Most of the surplus is producers' stocks. It is estimated that in 1985 domestic mine production will be zero and U.S. apparent consumption will be about 9,500 tons. From a 1983 base, demand for cobalt is expected to increase at an average annual rate of about 3% through 1990.

By the end of 1984, the 3,250 tons of cobalt purchased by GSA in 1983 was expected to have arrived in the United States. The cobalt, destined for the National Defense Stockpile, was supplied by Zaire and Zambia.

Cobalt is almost invariably recovered as a byproduct of copper and nickel mining. Environmental problems encountered with cobalt recovery are generally those associated with the mining and processing of copper and nickel ores.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	-	-	950,000
Australia	2,000	2,000	100,000
Canada	1,746	2,000	285,000
Finland	1,000	1,200	37,500
New Caledonia	300	300	950,000
Philippines	660	200	440,000
Zaire	12,460	14,000	2,300,000
Zambia	3,580	4,000	600,000
Other Market Economy Countries	430	500	1,300,000
Cuba	1,820	2,200	2,000,000
U.S.S.R.	2,600	2,700	250,000
World Total (may be rounded)	26,596	29,100	9,200,000

10. World Resources: The cobalt resources of the United States are estimated to be about 1.4 million tons. Most of these resources are in Minnesota, but other important occurrences are in Maine, Missouri, Idaho, Montana, California, Oregon, and Alaska. Although large, most domestic resources are in subeconomic concentrations that will not be economically useable in the foreseeable future. The identified world cobalt resources are about 12 million tons. The vast majority of these resources are in nickel-bearing laterite deposits, with the rest occurring in nickel-copper sulfide deposits hosted in mafic and ultramafic rocks and in the sedimentary copper deposits of Zaire and Zambia. In addition, millions of tons of hypothetical and speculative cobalt resources exist in manganese nodules and crusts on the ocean floor.

11. Substitutes: Nickel may be substituted for cobalt in several applications but only with a loss of effectiveness. Various potential substitutes include nickel, platinum, barium or strontium ferrite and iron in magnets; tungsten, molybdenum carbide, ceramics, and nickel in machinery; nickel and ceramics in jet engines; nickel in catalysts; and copper, chromium, and manganese in paints.

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COLUMBIUM

(Data in thousand pounds of columbium content, unless noted)

1. Domestic Production and Use: There has been no significant columbium mining industry since 1959, the exception being small unreported quantities of columbium-bearing concentrates produced in 1980-82. Most metal, ferrocolumbium, other alloys, and compounds were produced by eight companies with nine plants. Feed for these plants included imported concentrates, tin slags, columbium oxide, and ferrocolumbium. Consumption was mainly as ferrocolumbium by the steel industry and as columbium alloys and metal by the aerospace industry with plants located in the Eastern and Midwestern United States, California, and Washington. Total estimated value of shipments of domestically produced ferrocolumbium, nickel columbium, and metal was about $35 million. End uses as metal and alloys in fabricated form were: Construction, 40%; transportation, 26%; oil and gas industries, 13%; machinery, 12%; and other, 9%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Mine production	Small	Small	Small	-	-
Imports for consumption:					
Concentrates, tin slags, and other 1/	3,810	1,892	e/1,225	W	2,400
Ferrocolumbium	5,918	6,068	3,128	2,539	5,000
Exports: Concentrate, metal, alloys, waste, and scrap e/	171	91	88	78	110
Shipments from Government stockpile excesses	-	-	-	-	-
Consumption, reported:					
Raw material	3,122	1,983	e/1,900	e/1,900	2,000
Ferrocolumbium 2/	6,503	6,244	3,679	4,318	5,000
Consumption, apparent	7,607	8,118	6,600	5,750	6,800
Prices: Columbite, dollars per pound 3/	10.96	9.83	8.88	6.00	5.50
Pyrochlore, dollars per pound 4/	2.91	3.25	3.25	3.25	3.25
Industry stocks: Processor and consumer, yearend	8,581	8,332	e/5,971	W	NA
Employment: Processor e/	700	600	500	500	500
Net import reliance 5/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: Insignificant.

4. Import Sources (1980-83): Brazil 75%, Canada 7%, Thailand 6%, Other 12%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Columbium oxide	423.0050	4.0% ad val.	3.7% ad val.	25.0% ad val.
Columbium carbide	423.0094	4.0% ad val.	3.7% ad val.	25.0% ad val.
Columbium concentrate	601.2100	Free	Free	Free
Ferrocolumbium	606.5300	5.0% ad val.	5.0% ad val.	25.0% ad val.
Columbium, unwrought:				
Metal, waste, and scrap	628.1500	4.0% ad val.	3.7% ad val.	25.0% ad val.
Alloys	628.1700	5.6% ad val.	4.9% ad val.	25.0% ad val.
Columbium, wrought	628.2000	6.4% ad val.	5.5% ad val.	45.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Metal, alloys, synthetic concentrates, and columbium oxide.
2/ Includes nickel columbium and a small quantity of other columbium materials.
3/ Average value, contained pentoxides for material having a Cb_2O_5 to Ta_2O_5 ratio of 10 to 1.
4/ Average value, contained pentoxide.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 180 for definitions.
7/ Excluding Centrally Planned Economies.

Prepared by L. D. Cunningham, telephone number (202) 634-1024.

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7. Government Stockpile: In addition to quantities shown below, the stockpile contains 869,000 pounds in nonstockpile-grade columbium concentrate and 333,000 pounds in nonstockpile-grade ferrocolumbium. Bids solicited by the General Services Administration to supply approximately 400,000 pounds of columbium contained in concentrates for the National Defense Stockpile were rejected for being too high in price and not conforming to prevailing market conditions.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 months
Columbium:				
Carbide powder	100	21	-	-
Concentrate	5,600	937	-	-
Ferrocolumbium	-	598	-	-
Metal	-	45	-	-

8. Events, Trends, and Issues: Overall reported consumption of columbium continued to advance, up 15% from that of the previous year, reflecting increased demand in the steelmaking industry. Leading the advance was columbium consumption in high-strength low-alloy steels, resulting from strengthening demand in the automotive industry. Also, columbium consumption in superalloys continued to rise, about 20%, due to increased demand in the military aircraft sector. Imports of both columbium concentrates and ferrocolumbium rose substantially from the 1983 levels. Contrary to strengthening demand, the price of steelmaking grade ferrocolumbium, unchanged since midyear 1982, was lowered by 6% in the first quarter of 1984 to about $5.60 per pound of columbium content. High-purity ferrocolumbium and nickel columbium experienced modest price increases in the fourth quarter and were being quoted at $17.70 and $19.70 per pound of columbium content, respectively. From a 1983 base, demand for columbium is expected to increase at an average annual rate of about 5% through 1990. It is estimated that in 1985 domestic mine production of columbium will be zero and U.S. apparent consumption will be 7 million pounds.

New effluent limitations guidelines and standards for nonferrous metals manufacturing, including columbium, were set by the Environmental Protection Agency (EPA) in the March 8, 1984, Federal Register, Vol. 49, No. 47, Part II. Also, EPA proposed effluent limitations guidelines and standards for nonferrous metals forming operations. The proposal includes columbium and was being considered in 1984.

There are no known uncontrollable health hazards connected with production or fabrication of columbium metals and compounds. Fumes, gases, dust, and low-level radiation generated by columbium-processing plants can be controlled by modern technology.

9. World Mine Production and Reserve Base:

	Mine Production e/		Reserve Base 6/
	1983	1984	
United States	-	-	Negligible
Brazil	15,270	18,000	8,000,000
Canada	2,870	4,700	700,000
Nigeria	110	100	200,000
Zaire	48	50	200,000
Other Market Economy Countries	382	370	19,000
Centrally Planned Economies	NA	NA	NA
World Total (may be rounded)7/	18,680	23,000	9,100,000

10. World Resources: Most of the world's identified resources of columbium lie outside the United States and occur mainly as pyrochlore in carbonatite deposits. On a worldwide basis, resources are more than adequate to supply projected needs. The United States has approximately 800 million pounds of columbium resources located in identified deposits, which were considered uneconomic at 1984 prices for columbium.

11. Substitutes: The following materials can be substituted for columbium, but a performance or cost penalty may ensue: Vanadium and molybdenum in high-strength low-alloy steels; tantalum and titanium in stainless and high-strength steel and superalloys; and molybdenum, tungsten, tantalum, and ceramics in high-temperature applications.

January 1985

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COPPER

(Data in thousand metric tons of copper content, unless noted)

1. Domestic Production and Use: Domestic mine production in 1984 was 1.0 million tons, valued at $1.5 billion. The principal mining States were Arizona, New Mexico and Utah, but seven other States also yielded copper. Thirty-one mines accounted for 99% of the estimated 1984 mine production. By yearend, however, 6 of these mines had either closed or curtailed production, 1 refinery was closed permanently, 4 of the 13 remaining refineries were either closed or operating on a reduced level, 2 of the 12 electrowinning plants had closed, and 4 of the 15 primary smelters had stopped operating. One smelter was expected to close permanently in 1985. Copper was fabricated at 20 wire rod mills, 42 brass mills and 980 foundries, chemical plants and miscellaneous manufacturers. Copper consumption in 1984, by industrial sector, was 1/: Building construction, 34%; electrical and electronic products, 24%; industrial machinery and equipment, 16%; transportation, 12%; and consumer and general products, 14%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	1,181	1,538	1,140	1,038	1,050
Refinery--Primary 2/	1,211	1,544	1,227	1,182	1,220
Secondary 3/	515	494	468	401	310
Copper from old scrap, all sources	614	598	518	455	450
Imports for consumption: Ores and Concentrates	52	39	118	91	9
Refined	427	331	258	460	440
All imports	554	438	513	654	540
Exports: Ores and Concentrates	107	151	195	50	53
Refined	14	24	31	81	87
All exports	193	303	345	239	286
Consumption: Refined, reported	1,862	2,025	1,658	1,767	2,110
Apparent, total 4/	2,175	2,278	1,760	2,020	2,100
Price, average, cents per pound:					
Domestic producer cathode	101.3	84.2	72.8	76.5	66.0
London Metal Exchange cathode	96.1	79.0	65.6	70.3	63.0
Stocks, yearend, refined 5/	294	465	676	672	590
Employment, mine and mill	27,500	30,600	20,600	14,700	15,000
Net import reliance 6/ as a percent of apparent consumption	16	6	1	19	21

3. Recycling: Old scrap, converted to refined metal and alloys, provided 450,000 tons of copper, or 21% of apparent consumption. New scrap, derived from fabricating operations, yielded 670,000 tons of contained copper. Of the total copper recovered from scrap, smelters and refiners recovered 50%, brass mills, 45%, and miscellaneous manufacturers, foundries and chemical plants, 5%. About 27% was recovered as refined copper. Eighty percent of the copper contained in new scrap was recovered at brass mills.

4. Import Sources (1980-83): Chile 42%, Canada 24%, Mexico 8%, Peru 8%, Other 18%.

5. Tariff:

Item:	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore	602.30	Free	Free	4¢/lb
Black copper, blister anode	612.03	1.1% on the value of copper content	1.0% on the value of copper content	6.0% ad val.
Refined, unwrought	612.06	1.0% ad val.	1.0% ad val.	6.0% ad val.
Waste and scrap	612.10	0.4% ad val.	Free	6.0% ad val.

e/ Estimated.
1/ Copper used in electrical components in each end use is distributed among industrial sectors.
2/ From domestic and imported materials.
3/ From new and old scrap, at primary and secondary refineries.
4/ Defined as primary refined production + copper refined from old scrap + copper recovered in alloys from old scrap + refined imports - refined exports ± changes in refined stocks.
5/ Held by refineries, mills, miscellaneous manufacturers and by Commodity Exchange Inc.
6/ Defined as imports - exports + adjustments for Government and industry stock changes.
7/ See page 180 for definitions.

Prepared by Janice L. W. Jolly, telephone number (202) 634-1071.

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6. Depletion Allowance: 15% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--11/30/84				
Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Copper	907	20	-	-

8. Events, Trends, and Issues: U.S. mine production in 1984 remained at the depressed level of 1983. A substantial portion of U.S. mine capacity was idled as several mines either closed or cut back production during the year. Mine production in the rest of the world also continued at rates similar to those of 1983.

Despite increased consumption and a modest decline in copper inventories, refined copper prices in 1984 retreated to the lowest level in real terms in 40 years. A major problem facing U.S. producers of copper was the sustained strength of the U.S. dollar in international currency markets and devaluations by other copper producing countries; this placed U.S. producers at a disadvantage in the domestic and international markets.

Apparent consumption of refined copper in the United States in 1984 increased fractionally above that of 1983. It is estimated that in 1985 U.S. apparent consumption will be 2.2 million tons and domestic mine production will be 1 million tons. From a 1983 base, demand for copper in the United States is expected to increase at an average annual rate of 1.8% through 1990.

In 1984 U.S. producers continued to reduce production costs through improved technology, revised production schemes and reduced labor costs. In October, the weighted average production cost, averaged over the life of the mine, for 15 operating U.S. mines was estimated to be 73 cents per pound at zero rate of return. New initiatives such as installation of flash smelters, in-pit crushers, belt transport systems, larger flotation cells and computerized control systems were instituted.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 7/
	1983	1984 e/	
United States	1,038	1,050	90,000
Australia	256	250	16,000
Canada	625	625	32,000
Chile	1,257	1,250	97,000
Peru	322	370	32,000
Philippines	273	250	18,000
Zaire	535	525	30,000
Zambia	543	540	34,000
Other Market Economy Countries	1,228	1,300	101,000
Poland	380	380	15,000
U.S.S.R. e/	1,000	1,000	36,000
Other Centrally Planned Economies	587	580	9,000
World Total	8,044	8,120	510,000

10. World Resources: Land-based resources are estimated at 1.6 billion tons of copper and resources in deep sea nodules at 0.7 billion tons. About 85% of the land-based resource is located in the market economy countries.

11. Substitutes: Other materials may substitute for copper in some applications, such as aluminum in electrical equipment, automobile radiators, and refrigerator tubing, titanium and steel in heat exchangers, steel in shell casings, optical fiber in telecommunications cable and plastics in water pipe and plumbing fixtures.

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CORUNDUM

(Data in short tons of corundum, unless noted)

1. Domestic Production and Use: There has been no reported sustained production of abrasive-grade corundum since 1906. In recent years the domestic supply has consisted almost entirely of material imported by one firm in Massachusetts. In 1984, another firm, also in that State, accounted for one-half of domestic consumption. Corundum was used in grinding and polishing optical components, 60%; fabricated metal products, 25%; and other, 15%. U.S. processed corundum consumption was valued at $1.1 million.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production			None		
Imports for consumption 1/	-	-	-	-	-
Exports 2/	-	-	-	-	-
Consumption, apparent 3/	1,500	1,100	650	725	710
Price: Average value, dollars per ton:					
Crude	-	-	-	-	-
Processed	1,420	1,500	1,540	1,540	1,540
Stocks, yearend	3,856	2,756	2,100	1,375	665
Employment: Mill	13	10	7	7	7
Net import reliance 4/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1980-83) 1/: None.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	519.17	Free	Free	Free
Graded material	519.37	0.3¢/lb	0.3¢/lb	1.0¢/lb

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ The most recent shipment, 4,867 tons, of corundum was imported from the Republic of South Africa in 1979 and accounted for 100% of the imports for that year.
2/ Export data are not available and are assumed to be zero for apparent consumption and net import reliance calculations.
3/ Apparent consumption is based on the major importer's estimate. Demand in 1980-84 was supplied from stocks.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.

Prepared by J. Fletcher Smoak, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: Demand for abrasive-grade corundum since 1979 has been met by withdrawal from stocks. The United Nations embargo on corundum was removed in 1979 upon the establishment of an independent Zimbabwe. However, the United States has not imported corundum from Zimbabwe directly since 1968. From a 1983 base, demand for corundum is expected to decrease at an average annual rate of about 1.4% through 1990. The primary cause for the continuing decrease in demand has been the increased use of plastics that do not require grinding and polishing for optical components, especially contact and eyeglass lenses, which had been the largest market for abrasive-grade corundum. It is estimated that in 1985 U.S. apparent consumption of corundum will be 690 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/
	1983	1984 e/	
United States	-	-	None
South Africa, Republic of	60	70	Small
Zimbabwe	9,400	9,400	Large
Other Market Economy Countries	1,100	1,300	Moderate
Centrally Planned Economies	9,600	9,600	Large
World Total (rounded)	20,200	20,400	Large

10. World Resources: Abrasive-grade corundum occurs in the United States in South Carolina, North Carolina, Georgia, Colorado, Montana, and Nevada. These resources are not well defined and are probably very small. The principal resources are in Zimbabwe, the Republic of South Africa, and the U.S.S.R. Corundum has also been found in other countries but the deposits have not been thoroughly evaluated.

11. Substitutes: Alternate competitive abrasives are garnet, diamond, fused aluminum oxide, and silicon carbide.

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DIAMOND (INDUSTRIAL)

(Data in million carats, unless noted)

1. Domestic Production and Use: Synthetic diamond production, exports and imports again attained new record levels in 1984. All industrial diamond produced domestically was synthetic grit in sizes suitable for use in saws, machine tools, drill bits, grinding wheels, and grinding and polishing, and was the output of five firms, one each in New Jersey, Ohio, and Michigan and two in Utah. Six firms recovered and sold industrial diamond as the principal product. About 50 firms recovered industrial diamond in secondary operations and the majority of these diamonds were either credited to the clients' account or reset in their bits or tools. Major uses of all industrial diamond were: Machinery, 27%; mineral services, 18%; stone and ceramic products, 17%; abrasives, 16%; contract construction, 13%; transportation equipment, 6%; and other, 3%. U.S. consumption was valued at about $110 million. The mineral services industry, primarily drilling, accounted for 74% of stone consumption.

2. Salient Statistics--United States: 1/

	1980	1981	1982	1983	1984 e/
Bort, powder, and dust--natural/synthetic:					
Production: Manufactured diamond	50.0	57.0	53.0	69.0	76.0
Secondary e/	1.9	1.8	1.2	1.2	1.5
Imports for consumption	15.6	14.4	14.3	18.8	36.2
Exports: Including reexports 2/	28.5	28.5	30.6	42.3	47.0
In manufactured products e/	6.2	7.8	6.4	7.7	11.7
Sales of Govt. stockpile excesses	0.7	-	1.5	0.2	-
Consumption, apparent	33.5	36.9	33.0	39.2	55.0
Price: Value of imports, dollars per carat	1.99	1.91	1.90	1.49	1.36
Net import reliance 3/ as a percent of apparent consumption:	Net exporter				
Stones--natural:					
Production: Mine	None				
Secondary e/ 4/	0.6	0.5	0.5	0.6	0.7
Imports for consumption	6.2	6.0	4.7	6.1	7.5
Exports: Including reexports 2/	3.6	2.3	1.9	3.2	3.2
In manufactured products e/	0.6	0.5	0.4	0.3	0.8
Sales of Govt. stockpile excesses	0.8	5/1.5	5/1.2	5/1.0	5/1.5
Consumption, apparent	3.4	3.7	2.9	3.2	4.2
Price: Value of imports, dollars per carat	12.84	13.93	12.60	9.98	8.35
Net import reliance 3/ as a percent of apparent consumption:	100	100	100	100	100

3. Recycling: About 2.2 million carats was salvaged in secondary production from salvage stone, sludge, and swarf.

4. Import Sources (1980-83): Bort, powder and dust--natural/synthetic: Ireland, 60%, Republic of South Africa, 9%, Japan, 6%, United Kingdom, 4%, Other 21%.
Stone: Republic of South Africa, 57%, Zaire 13%, United Kingdom, 8%, Belgium-Luxembourg, 7%, Other 15%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Synthetic diamond, other	520.21	4.1% ad val.	3.0% ad val.	30.0% ad val.
Miners' diamond, synthetic/natural	520.19,520.23	Free	Free	Free
Crushing bort	520.27	Free	Free	Free
Powder or dust, synthetic/natural	520.20,520.28	Free	Free	Free
Other: Not advanced in condition	520.29	Free	Free	Free

e/ Estimated.
1/ Industry stocks and employment were unknown.
2/ Excluding diamonds in manufactured abrasive products.
3/ Defined as imports - exports including reexports + adjustments for Government and industry stock changes.
4/ Secondary production consists of industrial diamond stones that were originally imported; therefore, this quantity was considered as imported for the import reliance calculations.
5/ Diamond stones sold from the Govt. stockpile excesses were apparently exported to Belgium as gem quality diamond; consequently, it was excluded from the apparent consumption calculations.
6/ See page 180 for definitions.

Prepared by J. Fletcher Smoak, telephone number (202) 634-1206.

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6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales 11 Months
Crushing bort	22.0	22.0	-	0.0
Industrial stones	7.7	14.0	6.3	1.5

8. Events, Trends, and Issues: From a 1980 base, demand for industrial diamond is expected to increase at an average annual rate of 4% through 1990. It is estimated that in 1985 U.S. apparent consumption of industrial diamond will be 55 million carats. The Wyoming Geological Survey and two mining companies independently continued diamond exploration near the Colorado-Wyoming border. One company identified a low grade diamond resource that averaged 0.005 to 0.01 carats per ton. Development of the kimberlite pipe mine at the Argyle diamond mines in Western Australia continued on schedule and within budget. Annual production of the $550 million venture was projected to be 25 million carats and the project was scheduled for completion by the end of 1985. The Argyle alluvial deposits, placed in production in 1983, experienced an anticipated decline in output because of depletion of the higher grade material. Domestic diamond synthesis in 1984 was more than adequate for the smaller sizes. However, synthesis of larger industrial diamond was not commercial; hence, the United States was dependent on imports of stones or sales of Government stockpile excesses. Prices for the smaller sizes have decreased as a result of competition between domestic synthetic diamond and imports of natural and synthetic diamond. Prices for larger sizes decreased since 1981 because demand for new imported stones declined while the bit and tool manufacturers attempted to reduce a large inventory accumulation, especially in the mineral services sector, and because of increased competition from synthetic polycrystalline diamond compacts and shapes.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 6/
	1983	1984 e/	
United States	-	-	Unknown
Australia	4.0	4.0	500
Botswana	6.4	6.8	125
Ghana	0.3	0.4	15
South Africa, Republic of	5.8	5.8	70
Zaire	8.3	8.5	150
Other Market Economy Countries	1.7	1.9	30
China	1.6	1.4	20
U.S.S.R.	7.0	7.2	80
World Total	35.1	36.0	990

10. World Resources: The potential for discovery of resources of diamond in the United States has improved. However, evaluation of deposits already discovered will take several more years. Technology has been developed to synthesize diamond for industrial use worldwide in the range of sizes of crushing bort, powder, and dust. World resources of natural industrial diamond in the stone-size range are unknown.

11. Substitutes: Competitive materials were cubic boron nitride, fused aluminum oxide, and silicon carbide as manufactured abrasive materials; and garnet, emery, and corundum as natural abrasive materials. Synthesized polycrystalline diamond was competitive with natural stones in some applications. Research continued on additional uses of synthetic polycrystalline compacts and shapes as substitutes for stones.

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DIATOMITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The estimated value of processed diatomite, f.o.b. plant, was $128 million in 1984. Seven companies with nine processing facilities in four States produced diatomite. California was the principal producing State and accounted for more than 50% of production. End uses of diatomite were: Filter aid, 62%; fillers and additives, 34%; and other, 4%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine 1/	689	687	613	619	640
Imports for consumption	2/	2/	2/	2/	2/
Exports	173	162	141	146	130
Consumption, apparent	516	525	472	473	510
Price: Average value, dollars per ton, f.o.b. plant	146.02	164.50	175.56	185.00	200.00
Stocks: Producer, yearend	36	36	36	36	36
Employment: Mine and plant e/	950	950	900	900	900
Net import reliance 3/ as a percent of apparent consumption		Net exporter			

3. Recycling: None.

4. Import Sources (1980-83): Mexico 75%, Other 25%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude or processed	522.11	Free	Free	Free

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Processed ore sold or used by producers.
2/ Less than 500 tons.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.
5/ Estimated diatomite content of moler production.

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8. Events, Trends, and Issues: The United States remained the largest producer and consumer of diatomite and exported processed diatomite to more than 50 countries, primarily for filtration use. From a 1983 base, demand for diatomite is expected to increase at an average annual rate of about 3% through 1990. It is estimated that in 1985 domestic mine production of processed diatomite will be 650,000 tons and U.S. apparent consumption will be 510,000 tons.

   All domestic mining is by open pit and conflicting land-use problems exist. Control of dust in mining is adequate due to the high moisture content of the crude ore. Almost all processing is enclosed to permit effective control of silica dust.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1983	1984 e/	
United States	619	640	500,000
Brazil	18	20	2,000
Denmark 5/	138	140	NA
France	265	270	2,000
Germany, Federal Republic of	47	50	NA
Iceland	28	30	2,000
Korea, Republic of	60	60	NA
Mexico	62	60	NA
Spain	72	70	NA
Other Market Economy Countries	63	60	NA
Centrally Planned Economies	305	300	NA
World Total (may be rounded)	1,680	1,700	2,000,000

10. World Resources: World resources of crude diatomite are adequate for the foreseeable future, but the need for diatomite near markets encourages development of new sources for the material.

11. Substitutes: Many alternate materials can be substituted for diatomite; however, the unique properties of diatomite assure a continuing acceptance for many applications. Expanded perlite, asbestos, and silica sand compete for filtration purposes although, in most instances, diatomite is a superior material. Alternate filler materials include talc, ground silica sand, ground mica, clay, perlite, vermiculite, and ground limestone. For thermal insulation, materials such as brick, clay, asbestos, mineral wool, expanded perlite, and exfoliated vermiculite can be used.

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FELDSPAR

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: U.S. feldspar production in 1984 had an estimated value of $23 million. The three largest producers accounted for 70% of the output, and the next three jointly supplied 20%. North Carolina provided 70% of the 1984 output, and five other States contributed smaller quantities.

   Production of lithium ores and mica yielded moderate quantities of byproduct or coproduct feldspar in 1984, and feldspar processors reported coproduct recovery of mica and silica sand.

   Feldspar is ground for use in industry to about 20 mesh for glassmaking and to 200 mesh or finer for most ceramic and filler applications. Major shipments went to Georgia, Illinois, Indiana, New Jersey, Ohio, Pennsylvania, Texas, and West Virginia, with lesser amounts going to at least 23 other States and foreign destinations, especially Canada and Mexico. In ceramics and glass, feldspar functions principally as a flux. Estimated 1984 end-use distribution of domestic feldspar was: Glass, 58%; pottery, 38%; porcelain enamel and miscellaneous applications, 4%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Marketable	710	665	615	710	710
Imports for consumption	1/	1/	1/	1/	1/
Exports	13	14	11	9	10
Consumption, apparent	697	651	604	701	700
Price, average, dollars per ton	32.70	31.60	33.00	31.70	32.40
Stocks, producer, yearend		Not available			
Employment: Mine and preparation plant	450	450	450	450	450
Net import reliance 2/ as a percent of apparent consumption		Net exporter			

3. Recycling: Insignificant.

4. Import Sources (1980-83): Canada 53%, Sweden 21%, Norway 14%, Other 12%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude	522.31	Free	Free	50¢/long ton
Ground	522.41	3.0% ad val.	2.8% ad val.	30% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Less than ½ unit.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.

Prepared by M. J. Potter, telephone number (202) 634-1180.

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8. Events, Trends, and Issues: U.S. mine production of feldspar was about the same as the average of the preceding decade (1974-1983). Housing construction in 1984 continued at a fairly good level of activity, as did the use of feldspar in plumbing fixtures, tile, and glass fiber for insulation. However, competition from plastic bottles continued to keep the output of glass containers flat. From a 1983 base, demand for feldspar is expected to increase at an average annual rate of about 1% through 1990. It is estimated that in 1985 domestic mine production of feldspar will be 720,000 tons and U.S. apparent consumption will be 710,000 tons. Use in glassmaking, feldspar's largest outlet, has been slowed since the 1950's by competition from imported nepheline syenite. The feldspar industry continued to be faced with high transportation costs.

   Imports of nepheline syenite in 1984 were an estimated 400,000 tons, or 2% less than in 1983.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983 e/	1984 e/	
United States	710	710	
Brazil	110	110	
France	190	200	Large in the
Germany, Federal Republic of	370	370	United States and
Italy	880	880	assumed to be
Mexico	120	120	large in other
Spain	135	140	countries.
Other Market Economy Countries	454	460	
U.S.S.R. e/	360	360	
Other Centrally Planned Economies	153	150	
World Total	3,482	3,500	

10. World Resources: Identified and hypothetical resources of feldspar are more than adequate to meet anticipated world demands. Quantitative data on hypothetical resources of feldspar existing in granites, pegmatites, and feldspathic sands have not been compiled. There is ample geologic evidence that resources are immense although not always conveniently accessible from the principal centers of consumption.

11. Substitutes: Feldspar can be replaced in some of its end uses by feldspar-silica mixtures, clays, talc, pyrophyllite, spodumene, or electric-furnace slag. Imported nepheline syenite, however, was the major alternative material.

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FLUORSPAR

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Four companies in three States shipped fluorspar valued at $12 million in 1984. Two producers in southern Illinois accounted for over 90% of domestic output. Small shipments from Nevada and Texas accounted for the remainder. Barite and zinc concentrates were the main coproducts of fluorspar mining and milling.

   Approximately 66% of the fluorspar consumed in the United States in 1984 went into the manufacture of hydrofluoric acid, a key ingredient in the aluminum, fluorochemical, and uranium industries. About 33% was consumed by steelmakers. The remainder was consumed in glass manufacture, welding rod coatings, enamels, and other end uses or products. Supplementing domestic supplies of fluorine were about 65,000 tons of fluosilicic acid (equivalent to 115,000 tons of fluorspar) recovered from 18 phosphoric acid plants processing phosphate rock and 2 plants producing hydrofluoric acid. About 60% of the fluosilicic acid was used in water fluoridation directly or to produce sodium silicofluoride; 20% was used to make chemicals for smelting primary aluminum; the remaining 20% was used for miscellaneous purposes.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Finished (all grades) 1/	93	115	77	e/ 61	70
Fluorspar equivalent from phosphate rock	69	75	64	117	115
Imports for consumption:					
Acid-spar	637	571	408	385	530
Met-spar	262	256	136	68	170
Fluorspar equivalent from hydrofluoric acid plus cryolite	169	167	162	146	190
Exports: Ceramic and acid grades	18	11	11	9	14
Consumption: Apparent 2/	1,018	898	618	614	800
Reported: Acid-spar	608	551	327	382	410
Met-spar 3/	368	382	203	182	230
Price, yearend: 4/ Acid-spar, dollars per ton	160-171	171	180	180	173
Met-spar, dollars per ton	110	110	110	125	125
Stocks, yearend: Mine (Finished)	9	13	11	W	W
Consumer	183	216	208	99	70
Employment, mine and mill e/	400	400	300	300	300
Net import reliance 5/ as a percent of apparent consumption	91	87	90	90	91

3. Recycling: Increasing quantities of fluorides were being recycled annually in the aluminum industry. There is no recycling in other consuming industries.

4. Import Sources (1980-83): Mexico 54%, Republic of South Africa 28%, China 6%, Italy 5%, Other 7%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Acid-grade (more than 97% CaF_2)	522.21	$2.10/long ton	$2.10/long ton	$5.60/long ton
Metallurgical-grade (less than 97% CaF_2)	522.24	13.5% ad val.	13.5% ad val.	13.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Shipments.
2/ Excludes fluorspar equivalent of fluosilicic acid, hydrofluoric acid, and cryolite.
3/ Includes fluorspar briquettes.
4/ Fluorspar prices, f.o.b. Illinois, are quotations from Engineering and Mining Journal.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 180 for definitions.

Prepared by Lawrence Pelham, telephone number (202) 634-1177.

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7. Government Stockpile: In addition to quantity shown below, the stockpile contains 899 tons of nonstockpile acid-grade material and 116,863 tons of nonstockpile metallurgical-grade material.

Stockpile status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Acid grade	1,400	895	-	-
Metallurgical grade	1,700	295	-	-

8. Events, Trends, and Issues: Domestic production increased from that of 1983 because of the major producer's response to increased demand. Production of fluorspar in the Western States continued to be uneconomic because high freight rates to the Midwestern and gulf coast consuming areas make domestic fluorspar and its products less competitive with those of foreign suppliers.

Fluorspar demand increased from 1983 levels primarily because of increased production of steel, aluminum, and chemicals. Continued economic recovery and new and expanded uses for fluorine chemicals are expected to increase long-term demand. From a 1983 base, demand for fluorspar equivalent is expected to increase at an average annual rate of about 2.7% through 1990. It is estimated that in 1985, domestic mine production of fluorspar will be 70,000 tons and U.S. apparent consumption will be 850,000 tons. Estimated fluosilicic acid production in 1985 is expected to be 65 tons, which is equivalent to approximately 115 tons of acid-grade fluorspar.

The average value of domestically produced fluorspar in 1984 remained at about $170 per ton. In Mexico, most restrictions on the export price of fluorspar were removed and the price allowed to float, effective January 1. Each producer was able to formulate its own price and therefore be more competitive in world markets. Quoted prices per ton for fluorspar, f.o.b. Mexican border, were $75.63 for metallurgical grade and $108.33 for acid grade, dry basis.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 6/
	1983	1984 e/	
United States	e/ 61	70	55,000
France	264	270	20,000
Italy	176	180	20,000
Kenya	88	100	29,000
Mexico	667	700	60,000
South Africa, Republic of	295	350	108,000
Spain	206	220	25,000
Thailand	227	240	7,000
United Kingdom	220	230	10,000
Other Market Economy Countries	304	350	52,000
China	528	530	70,000
Mongolia e/	761	800	65,000
U.S.S.R. e/	595	600	104,000
Other Centrally Planned Economies	282	350	20,000
World Total (may be rounded)	4,700	5,000	645,000

10. World Resources: Identified world fluorspar resources amount to approximately 290 million tons of contained fluorine. The U.S. fluorspar reserve base is estimated to be about 25 million tons of contained fluorine; resources of fluorine from phosphate rock are approximately 16 million tons. World resources of fluorine from phosphate rock are estimated to be 160 million tons.

11. Substitutes: Olivine or dolomitic limestone were being used as substitute fluxes for fluorspar. Gaseous hydrocarbons and carbon dioxide have been substituted for chlorofluorocarbons as aerosol propellants.

January 1985

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GALLIUM

(Data in kilograms of gallium content, unless noted)

1. Domestic Production and Use: In 1984, no domestic primary gallium production was reported. One company, in Quapaw, OK, recovered gallium from gallium arsenide scrap. Over 90% of the gallium consumed was for electronic applications, such as light emitting diodes, lasers, and bubble memories. These devices are incorporated into calculators, fiber optic circuits, and machine controls by over 40 firms.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Refinery		Not available			
Imports for consumption	6,175	5,536	5,199	7,294	10,000
Exports		Not available			
Consumption: Reported	8,810	6,810	6,660	6,425	7,000
Apparent		Not available			
Price: Dollars per kilogram	600	630	630	525	525
Stocks: Producer, yearend		Not available			
Employment: Refinery e/	20	20	20	20	20
Net import reliance 1/ as a percent of apparent consumption		Not available			

3. Recycling: Old scrap, none. Substantial quantities of new scrap generated in the manufacture of solid state semiconductor devices were reprocessed.

4. Import Sources (1980-83): Switzerland 52%, Federal Republic of Germany 14%, Canada 11%, Other 23%.

5. Tariff:

	Number	Most Favored Nation (MFN)		Non-MFN
		1/1/85	1/1/87	1/1/85
Gallium compounds	423.00	4.0% ad val.	3.7% ad val.	25.0% ad val.
Gallium metal	632.24	4.0% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: Not applicable.

7. Government Stockpile: None.

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.

Prepared by D. Kramer, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: Imports continued to supply most of the gallium needed in domestic electronic and other applications. From a 1983 base, demand for gallium is expected to increase at an average annual rate of about 10% through 1990. It is estimated that in 1985 U.S. apparent consumption of gallium will be 8,000 kilograms.

   Production of gallium and germanium is scheduled to start on March 1, 1985 from a new processing plant in Utah. The plant will get its raw material from a mine in Utah, where development began in October 1983, and is expected to produce 10,000 kilograms per year of gallium.

   Gallium metal and compounds are considered relatively nontoxic. There are no known environmental constraints on the recovery and use of gallium; however, environmental constraints are placed on arsenic, which may be recovered from gallium arsenide scrap.

9. World Mine Production and Reserve Base: Data on U.S. and world production of gallium were unavailable because the output of the few producing companies was proprietary. However, the 1984 world gallium production was believed to be about 17,000 kilograms.

   Gallium occurs in very small concentrations in many rocks and ores of other metals. Most of it was produced as a byproduct of treating bauxite and the remainder was produced from residues from zinc processing.

   Only part of the gallium present in bauxite and zinc ores was recoverable, and the factors controlling the recovery were proprietary. Therefore, a meaningful estimate of current reserves could not be made. The world bauxite reserve base is so large that much of it will not be mined for many decades; hence, most of the gallium in it can be considered to have only long-term availability.

10. World Resources: On the assumption that the average content of gallium in bauxite is 50 ppm, about 2 million kilograms of this metal are present in the bauxite reserves in Arkansas. The gallium in U.S. bauxite resources, which are mainly subeconomic deposits, is approximately 15 million kilograms. Some domestic zinc ores contain as much as 50 ppm gallium and, as such, could be a significant resource. World resources of gallium in bauxite are estimated to exceed 1 billion kilograms, and a considerable quantity could be present in world zinc reserves. The foregoing estimates apply to total gallium content; only a small percentage of this metal in bauxite and zinc ores is economically recoverable.

11. Substitutes: Liquid crystals made from organic compounds are used in visual display panels as substitutes for light-emitting diodes. Silicon and germanium are alternate materials for gallium in many semiconductor applications.

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GARNET

(Data in short tons of garnet, unless noted)

1. Domestic Production and Use: Garnet was supplied in 1984 by four firms, two in New York, one in Idaho, and one in Maine. Output was valued at $7.0 million. The end uses for garnet were: Abrasives in transport manufacturing, 49%; water filtration, 29%; finishing wood furniture, 9%; electronic components, 7%; ceramics and glass, 3%; and other, 3%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	26,909	25,451	27,303	29,767	36,200
Sold by producers	26,550	25,519	26,660	28,902	36,300
Imports for consumption			None		
Exports e/	3,800	3,270	3,400	3,200	3,400
Consumption, apparent	22,750	22,250	23,260	25,702	32,900
Price: Range of value, dollars per ton:	130-1,200	120-1,200	120-1,200	120-1,200	70-1,200
Stocks e/	6,359	6,290	6,933	7,798	7,698
Employment: Mine and Mill	e/140	115	120	130	130
Net import reliance 1/ as a percent of apparent consumption			Net Exporter		

3. Recycling: None.

4. Import Sources (1980-83): None.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude	520.11	Free	Free	Free
Grain	519.37	0.3¢/lb	0.3¢/lb	1.0¢/lb

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.

Prepared by J. Fletcher Smoak, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: From a 1983 base, demand for garnet is expected to increase at an average annual rate of about 2% through 1990. It is estimated that in 1985 domestic mine production will be 37,000 tons and U.S. apparent consumption will be 33,500 tons. The environmental effects of garnet mining are minor. Tailings from the quarrying operations in New York were used within the quarry property for fill and road maintenance. In Idaho, the land was restored after placer mining of the garnet-bearing gravel. Tailings from the quarrying operations in Maine were sold as a utility grit for nonskid surfaces and as a one pass airblasting medium.

   Construction of a new garnet processing plant has been completed in Geraldton, Western Australia. The plant will produce a range of grits for coated abrasives, and powders for a wide variety of polishing applications in addition to the normal range of garnet for impact finishing and liquid filtration.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 2/
	1983	1984 e/	
United States	29,767	36,200	25,000,000
Australia	1,500	4,000	7,000,000
India	6,000	6,000	10,000,000
Other Market Economy Countries	100	100	8,000,000
U.S.S.R.	500	500	11,000,000
China	2,200	3,000	Moderate to Large
World Total (may be rounded)	40,100	49,800	Large

10. World Resources: Large domestic resources of garnet are concentrated in coarsely crystal line gneiss in the vicinity of North Creek, NY. One of the world's largest known garnet deposits is being quarried in Rangley County, ME. The medium grained ore from this deposit has an unusually high garnet concentration of 50% to 60%. Significant resources of garnet occur also in Idaho, New Hampshire, and North Carolina. World resources of garnet are large.

11. Substitutes: Garnet is competitive in abrasive applications with natural and manufactured abrasives such as diamond, cubic boron nitride, fused aluminum oxide, and silicon carbide, and in water filtration with ilmenite, magnetite, and plastics.

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GEM STONES 1/
(Data in million dollars)

1. Domestic Production and Use: Output of gem stones was primarily from Arizona, 39%, and Nevada, 13%. It was estimated that 79,500 visitors found 1,400 diamonds in the Crater of Diamonds State Park in Park County, AR. In Emerald Creek, ID, 753 permits were issued to diggers, who found 824 pounds of gem garnet, most of which was asteriated. Test operations at the Yogo Gulch sapphire mine in Montana produced 100,000 carats of corundum, mostly of gem quality. Collection of gem materials was mainly by individuals for recreation. Major uses were jewelry, mineral collections, and industrial.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine e/	6.9	7.6	7.2	7.4	7.2
Imports for consumption	2,825	2,766	2,384	2,856	3,600
Exports, including reexports	1,112	958	749	731	680
Consumption, apparent	1,720	1,816	1,642	2,132	2,927
Price	Variable, depending on size, type, and quality				
Stocks, yearend	Not available				
Employment: Mine 2/	180	190	200	200	200
Net import reliance 3/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: Insignificant.

4. Import Sources (1980-83 by value): Belgium-Luxembourg 28%, Israel 22%, Republic of South Africa 20%, India 14%, Other 16%. Diamond imports were about 80% of total imports.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Natural precious and semiprecious stones	520.11	Free	Free	Free
Diamond, other, advanced in condition or value	520.31	5.6% ad val.	4.9% ad val.	30% ad val.
Diamond, cut, unset, less than 1/2 carat	520.32	Free	Free	10% ad val.
Diamond, cut, unset, over 1/2 carat	520.33	Free	Free	10% ad val.
Rubies, sapphires, cut, unset	520.35	Free	Free	10% ad val.
Marcasites, cut, unset	520.37	1.3% ad val.	Free	20% ad val.
Emeralds, cut, unset	520.38	Free	Free	10% ad val.
Other precious/semiprecious stones, jewelry	520.39	2.2% ad val.	2.1% ad val.	30% ad val.
Precious stones, n.s.p.f.	520.51	7.5% ad val.	7.5% ad val.	30% ad val.
Rock crystal, n.s.p.f.	520.54	7.1% ad val.	6% ad val.	50% ad val.
Semiprecious stones	520.61	21% ad val.	21% ad val.	50% ad val.
Synthetic gem stones, cut, unset	520.71	3.3% ad val.	3.1% ad val.	10% ad val.
Other synthetic gem stones	520.75	9% ad val.	6% ad val.	30% ad val.
Pearls, natural	741.05	Free	4/Free	10% ad val.
Pearls, cultured	741.06	2.2% ad val.	2.1% ad val.	10% ad val.
Pearls imitation	741.10	11% ad val.	5/8% ad val.	60% ad val.
Coral, cut but unset	741.15	2.2% ad val.	4/2.1% ad val.	10% ad val.
Gem stones, imitation, exc. beads	741.35	3% ad val.	6/2.8% ad val.	20% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Excluding industrial diamond, see pages 44-45.
2/ Estimate includes operators of fee site deposits.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Fixed rate for LDDCs. 2.1% ad val.
5/ Fixed rate for LDDCs. 8% ad val.
6/ Fixed rate for LDDCs. 2.8% ad val.
7/ Data in thousands of carats of gem diamond.
8/ See page 180 for definitions.

Prepared by J. W. Pressler, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: Imports of rough diamond for cutting, exclusive of industrial applications, were 1 million carats, valued at $330 million, a 13% increase in value compared with that of 1983. The Republic of South Africa was the source of 74% of these imports, enabling De Beers Consolidated Mines Ltd. to reduce some of its $1.9 billion stock of rough diamond. Imports of cut diamond also showed a substantial increase, 29%, further evidence of increased demand for this commodity. Imports from India of small gem diamond, averaging 20 points and valued at $116 per carat, amounted to 3.4 million carats, approximately 46% of all U.S. imports of cut diamond goods.

Except for a few gem diamond finds each year in Arkansas, U.S. production is nil. A small amount of other natural precious gems is produced in the United States and large quantities of better grade natural and synthetic gems are imported. The domestic commercial gem stone mining industry includes emerald in North Carolina; jade, opal, and sapphire in the Western States; star garnet from Idaho; turquoise in the Southwestern States; and tourmaline in Maine and California. From a 1984 base, output is not expected to grow through 1990. It is estimated that in 1985 the value of domestic mine production of gem stones will be $8.0 million, and the value of U.S. apparent consumption will be $2.9 billion. Natural stones commanded higher prices than synthetics for jewelry applications. Heat treatment of cheaper stones to enhance color and quality is commonly practiced.

About 100 kimberlite pipes, 14 of them yielding diamonds, were discovered in Wyoming since 1960 by private companies and the Wyoming Geological Survey. An airborne remote-sensing project for kimberlite detection was completed in 1983 and under interpretation in 1984. A $2.5-million beneficiation pilot plant was erected in Fort Collins, CO, for testing of large scale (up to 50-ton) kimberlite samples. Investigations and sampling were continuing. Prospecting and sampling of a diatreme in Michigan occurred.

9. World Mine Production and Reserve Base: 7/

	Mine Production 1983	Mine Production 1984 e/	Reserve Base 8/
United States	-	-	World reserves of gem diamond are substantial. No reserve data are available for other gem stones.
Angola	900	900	
Australia	2,170	2,140	
Botswana	4,300	4,530	
Brazil	80	90	
Central African Republic	230	230	
Ghana	30	30	
Guinea	15	15	
Guyana	4	5	
India	13	14	
Indonesia	5	6	
Liberia	132	140	
Namibia	915	900	
Sierra Leone	192	120	
South Africa, Republic of	4,554	4,500	
Tanzania	125	120	
Venezuela	100	100	
Zaire	3,172	3,200	
U.S.S.R.	3,700	3,700	
China	400	300	
World Total	21,037	21,040	

10. World Resources: The world gem diamond reserves are estimated to be about 250 million carats, including near-gem and cheap-gem material. Most of the reserves are in Africa, the U.S.S.R. (Siberia), and Western Australia. Estimation of a reserve base is now more volatile because of the changing economic evaluation of near-gem and cheap-gem materials.

11. Substitutes: Plastics, glass, metals, wood, paper, and other materials are substituted for gem stones. Synthetic materials of similar compositions substitute for natural gem stones.

January 1985

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GERMANIUM

(Data in kilograms of germanium content, unless noted)

1. Domestic Production and Use: Based on the 1984 average producer price, the value of domestic refinery production of germanium was about $21 million. Processed residues from certain domestic zinc ores, industry generated scrap, and imported raw materials were the source materials for germanium production in 1984. The domestic industry consisted of one primary producer in Oklahoma and three secondary producers in New York, Pennsylvania, and Texas. Companies consuming germanium were located primarily in the Northeast, Texas, and California. The major end uses for germanium were infrared optics, 50%; fiber optic systems, 15%; semiconductors (including transistors, diodes, and rectifiers), 15%; and detectors, 10%. Other applications for germanium included catalysts, phosphors, metallurgy, and chemotherapy.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Refinery e/	27,000	28,000	26,000	20,000	20,000
Imports for consumption 1/	3,000	10,000	6,000	6,500	6,000
Exports		Not available			
Consumption e/	32,000	38,000	42,000	35,000	35,000
Price, producer, yearend, dollars per kilogram: Zone refined, first reduction quality	784	1,060	1,060	1,060	1,060
Dioxide	487	660	660	660	660
Stocks, producer, yearend		Not available			
Employment: Plant 2/ e/	80	80	80	80	85
Net import reliance 3/ as a percent of apparent consumption		Not available			

3. Recycling: More than 50% of the metal used during the manufacture of most electronic and optical devices is routinely recycled as new scrap. As a result of dispersal in microelectronic devices, very little germanium is returned as old scrap. High purity optical devices may ultimately constitute a large source of recyclable material.

4. Import Sources (1980-83): Belgium-Luxembourg 54%, United Kingdom 12%, Federal Republic of Germany 8%, China 8%, Other 18%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Germanium dioxide	423.00	4.0% ad val.	3.7% ad val.	25.0% ad val.
Metal, unwrought, waste and scrap	628.25	4.0% ad val.	3.7% ad val.	25.0% ad val.
Metal, wrought	628.30	6.4% ad val.	5.5% ad val.	45.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: On June 29, the Federal Emergency Management Agency determined that germanium would be included in the National Defense Stockpile with a goal of 30,000 kilograms.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 months
Germanium	30,000	-	-	-

e/ Estimated. NA Not available.
1/ Estimated germanium content based on comparison of value per kilogram of imported germanium material with published producer price for germanium metal.
2/ Employment related to primary germanium refining is indirectly related to zinc refining.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.
5/ Excluding Zaire.

Prepared by P. A. Plunkert, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: The largest end use for germanium continued to be in lenses and windows used in the production of infrared sensing and identification systems. Germanium also continued to be used in fiber optic systems. The growth potential for new uses for germanium should more than offset losses of germanium uses owing to substitution of silicon for germanium semiconductors. It is estimated that in 1985, domestic refinery production of germanium will be 30,000 kilograms and U.S. apparent consumption will be 40,000 kilograms. From a 1978 base, demand for germanium is expected to increase at an average annual rate of about 5.8% through 1990.

   Germanium dioxide and gallium was expected to be recovered from a mine in Utah in March 1985. The mine was expected to produce 120 tons of ore per day. The plant capable of treating 100 tons of ore per day was expected to have an estimated annual production for the first 3 years of 10,000 kilograms of contained gallium and 17,900 kilograms of contained germanium.

   The U.S. producer prices for germanium metal and dioxide remained at the levels established in late 1981 ($1,060 and $660, respectively) through October 1984. However, increased supplies of imported materials caused some discounting from these prices during the year.

   Germanium has little or no effect upon the environment because it usually occurs only as a trace element in some ores and carbonaceous materials and only small quantities are employed in commerical usage.

9. World Production and Reserve Base:

	Plant Production e/		Reserve Base 4/
	1983	1984	
United States	20,000	20,000	500,000
Zaire	NA	NA	Large
Other Market Economy Countries	48,000	53,000	Large
Centrally Planned Economies	17,000	17,000	Moderate to Large
World Total	5/85,000	5/90,000	Large

10. World Resources: The readily available resources of germanium are in some zinc and lead-zinc-copper sulfide ores. If germanium were to be recovered from ash and flue dusts resulting from burning certain coals for power generation, potential worldwide germanium resources would become several billion kilograms.

11. Substitutes: Less expensive silicon has increasingly been substituted for germanium in certain electronic applications. Certain bimetallic compounds of tellurium, selenium, indium, and gallium may also be used; however, germanium is more reliable in some high-frequency and high-power applications and more economical as a substrate for some light emitting diode applications. In infrared guidance systems, zinc selenide or germanium glass can substitute for germanium metal but at the expense of performance.

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GOLD

(Data in million troy ounces of gold content, unless noted)

1. Domestic Production and Use: The domestic mining industry consisted of about 160 lode mines, nearly all in Western States; several dozen large placer mines, nearly all in Alaska; and hundreds of small lode and placer mines. Nearly 20% of domestic gold was recovered as a byproduct of processing base metals, chiefly copper. In 1984, 25 mines yielded 76% of the gold produced, and 8 of these accounted for about 53%. The value of 1984 mine production was about $840 million. Commercial-grade refined gold came from 27 producers; the number of fabricators was about 3,000. Nearly all jewelry manufacturing was centered in the New York, NY, and Providence, RI, areas. Estimated uses in 1984: jewelry and arts, 54%; industrial (mainly electronic), 34%; dental, 11%; small bars, etc., mainly for investment, about 1%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	0.97	1.38	1.47	1.96	2.30
Refinery: Primary	0.79	0.80	0.72	0.89	0.80
Secondary (incl. toll)	3.82	3.08	3.04	2.96	3.00
Imports 1/ 2/ 3/	4.54	4.65	4.92	4.59	7.70
Exports 2/	6.12	6.44	2.97	3/3.14	5.10
Consumption: Reported	3.22	3.28	3.42	3.06	3.30
Apparent	3.60	3.50	4.10	4.10	4.80
Price: Average selling, dollars per ounce	612.56	459.64	375.91	424.00	365.00
Stocks, yearend: Treasury 4/	264.33	264.12	264.05	263.41	262.70
Industry	0.87	0.64	0.78	0.63	0.60
Assigned to futures trading	5.00	2.45	2.30	2.53	2.40
Employment: Mine and mill e/	5,500	7,500	6,800	5,200	5,000
Net import reliance 5/ as a percent of apparent consumption	18	15	32	19	16

3. Recycling: Of an estimated 3 million ounces of gold reclaimed from scrap in 1984, about 1.7 million ounces was from old scrap. The balance was from prompt industrial scrap, partly toll-refined. Old scrap supplied about 53% of the gold consumed.

4. Import Sources (1980-83): Canada 54%, Switzerland 9% (mostly Republic of South African origin), Uruguay 6%, other 31%. 2/

5. Tariff: Most forms of imported gold are not dutiable; duties on some items are as follows:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Platinum or silver-plated	605.27	9.6% ad val.	7.5% ad val.	65.0% ad val.
Unwrought or semimanufactured	605.28	11.2% ad val.	8.2% ad val.	65.0% ad val.
Rolled	605.60	7.9% ad val.	6.5% ad val.	30.0% ad val.
Compounds	418.80	5.0% ad val.	5.0% ad val.	25.0% ad val.

6. Depletion Allowance: 15% (Domestic), 14% (Foreign).

7. Government Stockpile: No strategic stockpile. However, the U.S. Department of the Treasury maintains stocks of gold (see section 2 above) and a Government-wide precious metals recovery program was begun in early 1984.

e/ Estimated.
1/ Imports for consumption.
2/ Excludes gold contained in fabricated items and official monetary gold movement; also excludes estimates of imported gold coin containing, in million ounces; 3.1 (1980), 2.6 (1981), 2.9 (1982), 1.9 (1983), 3.3 (1984 e/).
3/ Excludes net bullion flow (in million ounces) to market from:
-Foreign stocks at the New York Federal Reserve Bank: 1.89 (1980), 1.18 (1981), 1.33 (1982), -0.2 (1983), 0.80 (1984 e/).
-Sales of International Monetary Fund stocks: 2.2 (1980).
4/ Includes gold in Exchange Stabilization Fund. Stocks were valued in billion dollars at 11.16 (1980), 11.15 (1981), 11.15 (1982), and 11.12 (1983), 11.09 (1984 e/).
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 180 for definitions.

Prepared by J. M. Lucas, telephone (202) 634-1070.

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8. Events, Trends and Issues: The rapid pace of new gold discoveries and mine openings during recent years slowed somewhat during 1984 as companies pursued the development of earlier finds. Gold exploration continued at a brisk pace in favorable areas. Increases in gold mine production more than offset declines in byproduct gold from recently curtailed copper mine production. Reported consumption of gold in 1984 increased only marginally from the previous year. It is estimated that in 1985 domestic mine production of gold will be nearly 3 million ounces and U.S. apparent consumption will be about 4.9 million ounces. From a 1981 base, demand for gold is expected to increase at an average annual rate of about 2.0% through 1990.

The price of gold, though lower in 1981-84 than the record high level of 1980, remained well above levels established prior to 1980. The relatively high prices of recent years encouraged exploration for, and development of, new gold deposits, especially in the Western States. The Engelhard Industries/London daily final gold price began 1984 at $383 per troy ounce, peaked at nearly $406 in early March, declined to a low of $334 in early November and near the end of November stood at $342. The monthly volume of gold futures contracts traded on U.S. futures exchange markets began the year at nearly 80 million ounces and, in spite of declines at midwestern exchanges, trading exceeded 100 million ounces by midyear. However, toward yearend the volume declined to less than 70 million ounces.

Environmental pollution abatement continued to be of concern to domestic gold producers, especially in Alaska, where there are many small placer mines.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 6/
	1983	1984 e/	
United States	1.96	2.30	100
Australia	1.00	1.10	30
Canada	2.30	2.50	50
South Africa, Republic of	21.85	22.00	800
Other Market Economy Countries	6.62	6.20	210
China e/	1.90	2.00	} 260
U.S.S.R. e/	8.60	8.60	
Other Centrally Planned Economies e/	0.30	0.30	
World Total (May be rounded)	44.53	45.00	1,450

In addition to mine reserves, the world's above-ground stocks totaled at least 2.1 billion ounces, of which 1.14 billion ounces were official stocks of the market economy countries, 0.9 billion ounces were privately held, and 0.07 billion ounces were estimated official stocks of centrally planned economy countries.

10. World Resources: Total world resources of gold are estimated at 2.4 billion ounces, of which 15% to 20% are byproduct resources. The Republic of South Africa has about one-half of world resources, and the U.S.S.R., Brazil, and the United States about 12% each. Some of the 0.28-billion-ounce U.S. resource would be recovered as byproduct gold.

11. Substitutes: Base metals clad with gold alloys are being used increasingly in electrical/electronic and jewelry products to economize on gold; many of these products are being redesigned to maintain high utility standards with less gold content. Generally, palladium, platinum, and silver may substitute for gold.

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GRAPHITE (NATURAL)

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Natural graphite was again produced domestically in 1984. Apparent consumption of natural graphite, 46,000 tons valued at $15.0 million, was by several hundred manufacturing firms located primarily in the northeastern and Great Lakes regions. The main uses of natural graphite were estimated to be: refractories, 25%; dressings and molds in foundry operations, 20%; lubricants, 10%; brake linings, 9%; steel production, 8%; crucibles, 5%; and other, 23%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	-	-	W	W	W
Imports for consumption	58	66	53	44	54
Exports	9	11	10	9	8
Consumption, apparent	49	55	W	W	W
Price: Imports (average dollars per ton at foreign ports):					
Flake	585	641	655	550	520
Lump and chip (Sri Lankan)	971	1,509	1,512	1,158	1,120
Amorphous (Mexican)	42	45	54	56	47
Stocks, yearend	Not available				
Employment: Mine, mill, and processing plant	-	-	W	W	W
Net import reliance 1/ as a percent of apparent consumption	100	100	W	W	W

3. Recycling: None.

4. Import Sources (1980-83): Mexico 61%, China 13%, Brazil 8%, Madagascar 6%, Other 12%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crystalline flake (not including flake dust):				
Valued not over 5.5¢/lb	517.21	4.1% ad val.	3% ad val.	1.65¢/lb
Valued over 5.5¢/lb	517.24	0.3¢/lb	0.3¢/lb	1.65¢/lb
Lump and chip	517.27	Free	Free	30% ad val.
Other	517.31	Free	Free	10% ad val.

6. Depletion Allowance: 22% (Domestic lump and amorphous), 14% (Domestic flake), 14% (Foreign).

7. Government Stockpile: In addition to data shown below, the stockpile contained 935 tons of nonstockpile-grade material.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Sri Lanka, amorphous lump	6	5	-	-
Madagascar, crystalline flake	20	18	-	-
Other than Sri Lanka and Madagascar crystalline	3	2	-	-

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.
3/ Excluding U.S. production.

Prepared by H. A. Taylor, telephone number (202) 634-1180.

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8. Events, Trends, and Issues: Availability of graphite was adequate during 1984. Demand was met largely by imports of flake from Brazil, Madagascar, and China, lump and chip from Sri Lanka, and amorphous graphite from Mexico and China. Amorphous graphite accounted for 58% by quantity and 11% by value of total imports in 1984, crystalline flake accounted for 20% by quantity and 39% by value, and lump and chip accounted for 2% by quantity and 7% by value. Imports of all kinds of graphite were up 23% from that of 1983; imports of crystalline flake were up 55%; and imports of amorphous materials from Mexico increased about 23%. Exports decreased significantly and remained relatively small.

From a 1980 base, demand for natural graphite is expected to increase at an average annual rate of about 3% through 1990. It is estimated that in 1985 some natural graphite will continue to be produced in the United States and U.S. apparent consumption of graphite will be 45,000 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 2/
	1983	1984 e/	
United States	W	W	1,100
Austria	28	30	Large
India	39	40	Moderate
Korea, Republic of	34	35	Large
Madagascar	15	15	Large
Mexico	39	40	Large
Sri Lanka	9	10	Moderate to Large
Other Market Economy Countries	65	60	Moderate
Centrally Planned Economies	416	410	Large
World Total (may be rounded) 3/	645	640	e/170,000

10. World Resources: Domestic resources exceed 10 million tons, and the rest of the world's resources exceed 1.5 billion tons of recoverable graphite. One deposit in Montana was mined in 1984. Deposits in Alabama, Alaska, Idaho, New York, and Pennsylvania were not economically viable.

11. Substitutes: Substitute materials are more costly and/or do not perform as well as natural graphite for most applications. Manufactured graphite powder, scrap from discarded machined shapes, and calcined petroleum coke compete for use in iron and steel production. Finely ground coke with olivine is a potential competitor in foundry facing operations. Molybdenum disulfide competes as a dry lubricant but is more sensitive to oxidative conditions.

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GYPSUM

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1984, output of crude gypsum was 14.3 million tons valued at $117 million, an increase of 11% in tonnage compared with 1983. Leading States were Texas, Iowa, Oklahoma, California, Michigan, and Nevada, which together accounted for 57% of the total. Forty-two companies mined crude gypsum at 69 mines in 22 States, and 14 companies calcined gypsum at 70 plants in 30 States. Of the total supply of crude gypsum, 24.2 million tons, including 780,000 tons of byproduct gypsum, 19.7 million tons was calcined for gypsum products, and 4.5 million tons was used mainly as a cement retarder or as agricultural land plaster. The calcined gypsum was sold as prefabricated products or as industrial or building plaster. Sales of gypsum for use in cement were 3.0 million tons; for agriculture, 1.3 million tons; and for industrial and building plaster, 770,000 tons.

   Available capacity of operating gypsumboard plants in the United States at yearend 1984 was 21.0 billion square feet per year. Sales of gypsumboard products were 18.1 billion square feet, which represented a capacity utilization of 86%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Crude	12,376	11,497	10,538	12,884	14,300
Byproduct	663	696	697	760	780
Calcined	11,848	11,687	11,243	13,902	14,900
Prefabricated products (million square feet):	14,144	13,754	13,086	16,763	18,100
Imports: Crude, including anhydrite	7,365	7,593	6,718	8,031	8,900
Exports: Crude, crushed or calcined	88	157	123	117	130
Consumption: Crude, apparent 1/	21,013	19,288	17,383	22,599	24,300
Price: Average crude (f.o.b. mine) dollars per ton	8.33	8.53	8.46	7.87	8.20
Average calcine (f.o.b. plant) dollars per ton	22.82	20.80	17.48	19.43	20.20
Stocks: Producer, crude, yearend e/	3,203	3,544	3,991	2,950	2,500
Employment: Mine and calcining plant	6,300	6,300	5,900	6,500	6,600
Net import reliance 2/ as a percent of apparent consumption	35	37	36	40	38

3. Recycling: Byproduct gypsum generated in flue gas desulfurization, phosphate rock acidulation, and other chemical processes is not reclaimed, except for a small amount sold for agricultural purposes.

4. Import Sources (1980-83): Canada 73%, Mexico 20%, Spain 6%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude	512.21	Free	Free	Free
Ground, wholly or partly calcined	512.24	46¢/l.t.	42¢/l.t.	$1.40/l.t.
Gypsum or plaster building board	245.70	3.3% ad val.	2.4% ad val.	30% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Defined as crude + byproduct + imports - exports + industry stock adjustment.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.

Prepared by J. W. Pressler, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: The gypsum industry in 1984 followed the high activity of the construction and housing industry, with 1.8 million housing starts, a 6% increase compared with 1983. Production of domestic crude gypsum increased 11%, imports increased 11%, and sales of prefabricated products increased 10%.

In 1984, the gypsum wallboard industry continued the high rate of shipments established in the second half of 1973. This resulted in new monthly records for the first 5-months of 1984 and a high rate of shipments for the balance of the year. Total wallboard shipments for 1984 were 18.1 billion square feet, up 8% from 1983 and a new annual record. Most plants were on allocation to their best customers, and operated 160 of a weekly maximum of 168 hours. Some spot shortages developed in retail outlets and contractor requirements. The average price of wallboard in 20 principal cities increased about 18% from beginning to yearend. Imports of wallboard from Canada were 870 million square feet, 177% more than that of 1983, and a new record. One rehabilitated plant and two dormant plants came onstream; this, combined with one expansion project resulted in a yearend gypsumboard capacity of 21.0 billion square feet per year.

As long as the cost of land for solid waste disposal continues to be economical and solid waste pollution remains noncritical, only a small amount of the potentially useful byproduct gypsum scrubbed from powerplant stack gases and produced by chemical plants will be used.

From a 1983 base, demand for gypsum is expected to increase at an average annual rate of about 1.9% through 1990. It is estimated that in 1985 domestic mine production of gypsum will be 14 million tons and U.S. apparent consumption will be 24 million tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	12,884	14,300	500,000
Australia	1,980	2,000	800,000
Canada	8,250	9,100	
France	6,600	7,000	
Germany, Federal Republic of	2,000	2,100	
Iran	6,000	5,900	
Italy	1,400	1,400	Reserves are large
Japan	7,300	7,200	in major producing
Mexico	2,600	3,100	countries but data
Spain	5,500	5,500	are not available.
United Kingdom	3,400	3,400	
Other Market Economy Countries	12,700	12,800	
China	4,000	4,000	
Poland	1,430	1,450	
Romania	1,800	1,850	
U.S.S.R.	6,000	6,200	
Other Centrally Planned Economies	1,980	2,000	
World Total	85,824	89,300	Large

10. World Resources: Domestic resources are adequate but are unevenly distributed. There are no gypsum deposits on the eastern seaboard of the United States, and large imports from Canada augment the domestic supply of crude ore in these industrial areas. Large deposits occur in the Great Lake region, mid-continent region, California, and other States. Foreign resources are adequate but are not evenly distributed.

11. Substitutes: Other construction materials may be substituted for gypsum, especially lime, lumber, cement, steel, or masonry. There is no practical substitute for gypsum in portland cement. Byproduct gypsum is presently substituting for crude gypsum in special agricultural applications, and may, in time, be utilized in place of crude gypsum for cement set-retarding and manufacturing wallboard.

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HAFNIUM 1/

(Data in short tons of hafnium content, unless noted)

1. Domestic Production and Use: Hafnium is recovered as a byproduct in the production of hafnium-free, nuclear-grade, zirconium-base alloys. Two companies, one with a plant in Oregon and another with a plant in Utah, produced primary hafnium sponge and hafnium crystal bar. About 50% of the hafnium produced was used in naval nuclear reactors for control rods. Other uses were in ceramics, refractory applications, alloys, and as carbide in cutting tool alloys.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Sponge	W	W	W	W	W
Crystal bar e/	45	50	50	50	50
Imports for consumption			Negligible		
Exports			None		
Consumption, apparent: Sponge	W	W	W	W	W
Crystal bar e/	45	45	45	50	50
Price: Sponge, dollars per pound, domestic 2/	55-110	70-135	70-125	70-125	170-125
Stocks, yearend, sponge and crystal bar e/	35	35	35	35	35
Employment: Metal plant	3/	3/	3/	3/	3/
Net import reliance 4/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1980-83): France 91%, Federal Republic of Germany 5%, United Kingdom 4%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	(Non-MFN) 1/1/85
Unwrought hafnium, waste and scrap	628.35	1.3% ad val.	Free	25.0% ad val.
Wrought hafnium	628.40	9.0% ad val.	9.0% ad val.	45.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Zirconium.
2/ Price varies with quantities purchased.
3/ Small portion of primary zirconium metal plant employment.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.

Prepared by W. Timothy Adams, telephone number (202) 634-1082.

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8. Events, Trends, and Issues: Increased use of hafnium as an alloying agent in high temperature refractory alloys, and for hafnium-columbium carbide in cutting tool alloys continued in 1984. About one-half of the U.S. hafnium consumed was for naval nuclear reactors. It is estimated that in 1985 domestic production and U.S. apparent consumption of hafnium crystal bar will be 50 tons. From a 1978 base, demand for hafnium is expected to increase at an average annual rate of about 5% through 1990. Hafnium is available at reasonable cost as long as there is a continuing demand for reactor-grade zirconium.

9. World Mine Production and Reserve Base: Hafnium occurs in the mineral zircon, which usually contains about 2% hafnium. World primary hafnium production statistics are not available. The U.S. reserve base 5/ of hafnium associated with zircon amounts to about 80,000 tons.

10. World Resources: Resources of hafnium in the United States are estimated to be 140,000 tons, available in the 14-million-ton domestic resources of zircon. World resources of hafnium are associated with those of zircon, and exceed 500,000 tons.

11. Substitutes: There are no substitutes for hafnium in its major applications, nuclear reactor control rods and refractory metal alloys, but zirconium oxide and metal can be substituted in selected refractories and ceramics.

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HELIUM

(Data in million cubic feet of contained helium gas measured at 14.7 psia and 70° F)

1. Domestic Production and Use: During 1984, the estimated value of Grade-A (99.995% or better) helium extracted at the Bureau of Mines Exell Helium Plant was $12 million, and the estimated value of Grade-A helium extracted by private industry was $44 million. The total sales value for domestic consumption and exports was $56 million. Seven private industry plants and one Bureau of Mines facility extracted helium from natural gas; four of the privately owned plants were in Kansas, one in New Mexico, and two in Texas. The Grade-A helium produced was consumed principally in Western and Gulf Coast States. The estimated domestic consumption of 1,130 million cubic feet used in 1984 was predominantly 33% for cryogenic applications, 19% for welding cover gas, 18% for pressurizing and purging, and 8% for synthetic breathing mixtures for deep sea diving.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Helium extracted from natural gas 1/	1,458	1,065	232	575	1,000
Grade-A helium sales	1,161	1,255	1,245	1,363	1,500
Imports for consumption			None		
Exports 2/	298	389	378	368	370
Consumption, apparent 2/	863	866	867	995	1,130
Employment, plant e/	600	600	550	550	550
Net import reliance 3/ as a percent of apparent consumption			Net exporter		

Price: The Bureau's price of Grade-A gaseous helium, f.o.b. Bureau plants, was $37.50 per thousand cubic feet during 1984. Private producers of helium maintained their selling price of Grade-A helium gas at about $36 per thousand cubic feet, and the price of liquid helium at about $55 per thousand cubic feet, including surcharges.

3. Recycling: In the United States, helium used in large-volume applications is seldom recycled. Some low-volume or liquid boiloff recovery systems are used. In Western Europe and Japan, helium recycling is practiced when economically feasible.

4. Import Sources (1980-83): None.

5. Tariff:

	Number	Most Favored Nation (MFN)		Non-MFN
		1/1/85	1/1/87	1/1/85
Helium	415.50	4.0% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: Allowances are applicable to natural gas from which helium is extracted, but none is granted directly to helium.

7. Government Stockpile: In addition to the data shown below, the Bureau accepted 450 million cubic feet of private helium for storage and redelivered 650 million cubic feet for a net reduction in storage of 200 million cubic feet. On 11/30/84, 38.0 billion cubic feet of helium was in storage, of which 2.8 billion cubic feet was owned by private firms.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized for Disposal	Sales
Helium	None	35.2 billion cubic feet	None	None

e/ Estimated. NA Not available.
1/ Helium content of both Grade-A and crude helium consisting of approximately 70% helium and 30% nitrogen).
2/ Grade-A helium.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.
5/ All domestic measured and indicated helium resources in the United States.
6/ Excludes Other Market Economy Countries.

Prepared by Philip C. Tully and William D. Leachman. For further information call Armond A. Sonnek, Assistant Director--Helium Operations, (202) 634-4734.

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8. Events, Trends, and Issues: From a 1978 base, demand for helium is expected to increase at an average annual rate of about 7% through 1990. It is estimated that in 1985 domestic production of helium will be 1.1 billion cubic feet and U.S. apparent consumption will be 1.2 billion cubic feet.

9. World Production and Reserve Base:

	Production		Reserve Base 4/ 5/
	1983	1984 e/	
United States	575	1,000	483,707
France	-	-	NA
Other Market Economy Countries	NA	NA	NA
Centrally Planned Economies e/	150	150	NA
World Total 6/	725	1,150	NA

10. World Resources: For the United States, it is postulated that by the end of the century, the few large helium-rich natural gasfields that are currently supplying helium will be exhausted. Future supplies will come from known leaner sources, new helium-bearing natural gas wells, or from known helium-rich natural gas with little fuel value. As of December 31, 1984, approximately 58 billion cubic feet of helium was estimated to be in domestic natural gas reserves with a helium content of less than 0.3%. Shut-in and/or low-heating-value gasfields, having measured and indicated helium resources with a minimum helium content of 0.3%, were estimated to contain 120 billion cubic feet of helium.

Helium resources in the world exclusive of those in the United States and the centrally planned economies were estimated to be 193 billion cubic feet. The locations and volumes of the principal deposits in billion cubic feet are Algeria, 78; Canada, 70; and the Netherlands, 19. As of December 31, 1984, the Bureau of Mines had analyzed 17,625 gas samples from 36 countries in a program to identify world helium resources.

11. Substitutes: There is no substance that can be substituted for helium if temperatures below -429° F are required. Argon can be substituted for helium in welding, and hydrogen can be substituted for helium in some lighter-than-air applications where the flammability of hydrogen is not objectionable.

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ILMENITE 1/

(Data in thousand short tons of concentrate, unless noted)

1. Domestic Production and Use: Two firms produced ilmenite concentrate from three operations in Florida. Value of mine shipments in 1984 totaled $21 million. Major coproducts of ilmenite from sand deposits are zircon and rutile and at one hardrock deposit where ilmenite production was suspended in 1984, magnetite. Ilmenite and titanium slag were consumed by 13 companies. Four titanium pigment producers used 99% of the ilmenite and titanium slag consumed. The rest was used in welding-rod coatings and well-drilling muds, and for metal, alloys, carbide, and chemicals.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	549	542	263	W	W
Imports for consumption 2/	552	505	596	398	570
Exports	NA	NA	19	1	6
Consumption: Reported 2/	1,030	1,109	809	897	950
Apparent 2/	802	1,092	1,026	W	W
Prices, dollars per long ton:					
Ilmenite:					
54% TiO_2, f.o.b. Atlantic ports	55	70	70	70	70
Domestic, f.o.b. Titen, FL	-	39	44	44	44
Slag:					
70%-80% TiO_2, f.o.b. Sorel, Quebec 3/	115	135	150	162	185
85% TiO_2, f.o.b. Richards Bay, Republic of South Africa	137	175 e/	175 e/	180 e/	198
Stocks: Mine, distributor, and consumer, yearend 2/	1,103	1,058	878	548	420
Employment: Mine and mill 4/	650	603	446	367	375
Net import reliance 5/ as a percent of apparent consumption	32	50	74	W	W

3. Recycling: Insignificant.

4. Import Sources (1980-83) 2/: Australia 58%, Canada 35%, Republic of South Africa 6%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Titanium ore (including ilmenite and ilmenite sand)	601.5120	Free	Free	Free
Titanium slag	603.6200	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Rutile and Titanium.
2/ Includes titanium slag from Canada and the Republic of South Africa, and 7,000 to 15,000 tons per year leucoxene.
3/ Contained 70% to 72% TiO_2 in 1980-82, 74% TiO_2 in late 1982 to October 1983, then 80% TiO_2.
4/ Includes operating employees shown under Rutile, subject to the same footnoted comments.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 180 for definitions.
7/ Excluding U.S. production.

Prepared by L. E. Lynd, telephone number (202) 634-1073.

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8. Events, Trends, and Issues: In 1984 domestic mine production of ilmenite increased about 6%, but remained at a relatively low level because of suspended production at Tahawus, NY. Imports were 43% higher than those of 1983.

It is estimated that in 1985 U.S. consumption of ilmenite will be 1 million tons. From a 1981-82 average base, demand for ilmenite is expected to increase at an average annual rate of about 1.5% through 1990.

Environmental problems related to ilmenite include: (1) Land-use conflicts where black-sand deposits exist, principally along the Atlantic coast, and (2) the potential for water pollution from pigment-producing processes that use ilmenite - up to 3.5 tons of waste per ton of product using the sulfate process, and 1.2 tons of waste per ton of product from the chloride process. Solutions to the latter problem include the development of economic and environmentally acceptable processes for making synthetic rutile or titanium tetrachloride from lower grade ilmenites, and the development of methods to neutralize and control the effluents now produced. Two companies treated their spent acid effluent with calcium carbonate and lime, producing a gypsum byproduct which they sold to wallboard and cement manufacturers. One company upgrades part of its waste ferric chloride effluent for use in water treatment, and uses deep-well disposal of ferric chloride at most of its pigment plants.

The only domestic synthetic rutile plant, at Mobile, AL, continued in operation in 1984, using Australian ilmenite as feed material.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 6/
	1983	1984 e/	
United States	W	W	90,000
Australia	985	1,130	55,000
Brazil	17	17	43,000
Canada (Slag production)	675	770	164,000
Finland	170	170	3,000
India	200	200	63,000
Malaysia	120	120	2,000
Norway	600	730	182,000
South Africa, Republic of (Slag production)	420	420	133,000
Sri Lanka	90	90	42,000
Other Market Economy Countries	-	-	23,000
China	150	150	90,000
U.S.S.R.	475	475	15,000
World Total	7/3,902	7/4,272	905,000

10. World Resources: Ilmenite supplies about 90% of the world's demand for titaniferous material. World ilmenite resources total about 1 billion tons of titanium dioxide. Major resources occur in Australia, Canada, India, Norway, the Republic of South Africa, the United States, the U.S.S.R., and China.
11. Substitutes: Rutile and synthetic rutile were also extensively used to produce titanium dioxide pigment.

January 1985

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INDIUM

(Data in thousand troy ounces of metal, unless noted)

1. Domestic Production and Use: Domestic indium production was derived from residues generated in the refining of zinc and other base metal concentrates. Three companies refined indium from these materials during 1984. Several firms located in Eastern States produced high purity shapes, alloys and compounds from indium ingots. Estimated uses for the metal in 1984 were: Electrical and electronic components, 40%; solders, alloys, and coatings, 40%; and research and other, 20%. The estimated value of consumption in 1984, based on the average price, was $1.8 million.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Refinery		Not available			
Imports for consumption: Metal	299	461	686	1,071	1,000
Exports		Not available			
Consumption, estimated	600	500	500	500	600
Price, average annual, dollars per troy ounce	17.00	7.53	4.18	3.19	3.12
Stocks, producer, yearend		Not available			
Employment		Not available			
Net import reliance 1/ as a percent of apparent consumption		Not available			

3. Recycling: Insignificant.

4. Import Sources (1980-1983): Belgium-Luxembourg 24%, France 17%, Italy 17%, United Kingdom 14%, Other 28%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Unwrought, and waste and scrap	628.45	0.6% ad val.	Free	25.0% ad val.
Wrought	628.50	5.0% ad val.	3.6% ad val.	45.0% ad val.
Compounds	423.96	1.2% ad val.	Free	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.
3/ Excluding production from Other Market Economy Countries and the United States.

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8. Events, Trends, and Issues: In recent years, domestic indium production was estimated to have fluctuated within a relatively narrow band. In 1984, domestic production remained about the same as the previous year, demand increased slightly, and imports declined. It is estimated that in 1985 U.S. consumption of indium will be 600,000 troy ounces. From a 1978 base, domestic demand for indium is expected to increase at an average annual rate of about 3% through 1990.

In 1984, the domestic producer price of indium was increased in several stages from $2.65 to $3.30 per troy ounce toward yearend. No toxic effects have been reported for indium and no special treatment has been required to remove it from waste products at smelters.

Established uses for indium included plating on electronic components, low melting alloys, solders, coating on electrical contacts, dental alloys, nuclear reactor control rods, and infrared detectors. A growing use was as a transparent, electrically conductive coating on glass, such as used for liquid-crystal displays on wristwatches and calculators. Research continued on the use of indium in solar cells and on indium-tin oxide coatings for plastic films.

9. World Production and Reserve Base:

	Refinery Production		Reserve Base 2/
	1983 e/	1984 e/	
United States	NA	NA	5,000
Canada	100	-	9,000
Japan	200	200	1,000
Peru	150	150	2,000
Other Market Economy Countries	NA	NA	28,000
U.S.S.R.	200	200	2,000
Other Centrally Planned Economies	100	100	3,000
World Total	3/750	3/650	50,000

10. World Resources: Identified resources of indium occur primarily in zinc sulfide ores in many parts of the world. However, the indium content is not the same in all zinc ores.

11. Substitutes: Alternate materials are available for most uses of indium. In transistors, silicon has generally replaced germanium-indium. For some alloys, if cost is not an important factor, gallium can be used as a substitute. Boron carbide and hafnium can replace indium in nuclear reactor control rods.

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IODINE

(Data in thousand pounds, unless noted)

1. Domestic Production and Use: The large operation at Woodward, OK, and the long-established producer of byproduct iodine at Midland, MI, continued production of iodine from subterranean brines. A third company continued a pilot-size facility in Kingfisher County, OK, using brine associated with oil production. The value of apparent consumption of iodine for 1984 was estimated to be $38 million. Thirty-one plants reported consumption of crude elemental iodine. Prices began to rise and consumption of iodine decreased at yearend. Imports decreased because of large stocks accumulated during 1983.

   Demand for iodine was in the following downstream distribution categories: Catalysts, animal feed additives, pharmaceuticals, sanitary and industrial disinfectants, stabilizers, inks and colorants, photographic equipment, and other.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	W	W	W	W	W
Imports for consumption, crude	6,200	6,100	4,700	6,200	5,500
Exports	-	-	-	-	-
Shipments from Govt. stockpile excesses	-	37	445	50	139
Consumption, apparent	8,700	8,800	6,900	8,100	7,600
Price, average CIF value, dollars per pound, crude	4.72	6.03	5.97	5.57	4.78
Stocks, producer, yearend	W	W	W	W	W
Employment, processing plant	1/470	1/470	1/470	1/430	80
Net import reliance 2/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Iodine was recycled, but no data are available.

4. Import Sources (1980-83): Japan 80%, Chile 20%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Iodine, crude	415.25	Free	Free	Free
Iodine, resublimed	415.27	6.5¢/lb	6.0¢/lb	10.0¢/lb
Potassium iodide	420.20	3.0% ad val.	2.8% ad val.	7.5% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Programs: Shipments of crude iodine for domestic use from Government stockpile excesses were made from storage facilities in Stockton, CA and Somerville, NJ. In addition to the quantity shown below, the stockpile contains 4,474 pounds of nonstockpile-grade material available for disposal.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Stockpile grade	5,800	7,363	0	139

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Includes bromine.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.
4/ Excluding U.S. production.

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8. Events, Trends, and Issues: Chile continued to produce iodine as a coproduct of sodium nitrate extraction. All iodine produced in Chile during 1984 was sold. Production was less than in 1983 because of unusual weather conditions in the Atacama Desert, but production in 1985 is expected to increase over that of 1983.

The world's largest producer of iodine, Japan, produced iodine from gas brines.

The largest U.S. crude iodine facility was purchased by a Japanese company in August. The second largest producer announced a shutdown of its iodine facility at yearend.

The United States continued to depend on imports to supply over one-half of the U.S. demand. The primary impediment to full development of domestic reserves is the lack of a high quality reserve base to justify the capital expenditures.

From a 1982 base, demand for iodine is expected to increase at an average annual rate of about 0.5% through 1990. It is estimated that in 1985, U.S. apparent consumption will be 7.6 million pounds.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	W	W	550,000
Chile	6,000	5,800	450,000
Indonesia	57	55	100,000
Japan	16,034	15,000	2,000,000
Other Market Economy Countries	-	-	NA
China	1,000	1,000	400,000
U.S.S.R.	4,400	4,400	400,000
Other Centrally Planned Economies	-	-	NA
World Total (rounded)	4/27,500	4/26,300	4,000,000

10. World Resources: In addition to the fields listed in the reserve base, seawater contains 0.05 parts per million iodine, or approximately 76 billion pounds. Seaweeds of the Laminaria family are able to extract and accumulate up to 0.45% iodine on a dry basis. While not as economical as the production of iodine as a byproduct of gas, oil, and nitrate, the seaweed industry represented a major source of iodine prior to 1950 and a large resource.

11. Substitutes: Bromine and chlorine could be substituted for most of the biocide, ink, and colorant uses of iodine, although they are usually considered less desirable. Antibiotics and mercurochrome also substitute for iodine as biocides. Salt crystals and finely divided carbon may be used for cloud seeding. There are no substitutes in catalytic, nutritional, pharmaceutical, animal feed, and photographic uses.

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IRON ORE 1/

(Data in million long tons of ore, 2/ unless noted)

1. Domestic Production and Use: Mine value of usable iron ore produced from domestic mines in 1984 was estimated at $2.3 billion. Iron ore was produced by 17 companies operating 21 mines, 17 concentration plants, and 11 pelletizing plants. The mines included 20 open pits and 1 underground mine. Virtually all ore was concentrated before shipment, and about 98% was pelletized. Average iron content of usable ore was 64%. Twelve mines operated by nine companies accounted for 99% of the output. Domestic steel companies directly controlled about 79% of production. Minnesota produced about 71% of the output, Michigan 25%, and the rest was produced in five other States. Consumption of iron ore and agglomerates was distributed approximately as follows: Blast furnaces, 98.5%; steel furnaces, 0.5%; and manufacture of cement, heavy media materials and other products, 1%. Approximate consumption by region was: Illinois-Indiana-Michigan, 44%; Ohio-Pennsylvania, 33%; Maryland-West Virginia, 10%; most of the remainder was consumed in four other States.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	69.6	73.2	35.4	37.6	51.0
Imports for consumption	25.1	28.3	14.5	13.2	18.0
Exports	5.7	5.5	3.2	3.8	4.5
Consumption: Reported (ore and agglomerates)	98.9	104.4	63.9	70.6	75.0
Apparent	92.1	94.0	54.4	60.0	64.0
Price (November): Lake Superior ores, delivered rail of vessel at lower lake ports:					
Natural ores, basis 51.5% Fe, dollars per long ton	28.50-28.75	32.25-32.78	32.25-32.78	30.03-32.78	30.03-32.78
Pellets, cents per long ton unit of Fe	73.7	80.5	80.5-86.9	80.5-86.9	80.5-86.9
Stocks: Mine, dock, and consuming plant, yearend, excl. byproduct ore	53.5	55.5	47.8	3/31.9	33.0
Employment: Mine, concentrating and pelletizing plant; quarterly average	18,200	18,200	9,200	7,600	8,600
Net import reliance 4/ as a percent of apparent consumption (iron in ore)	25	22	34	37	19

3. Recycling: Insignificant.

4. Import Sources (1980-83): Canada 67%, Venezuela 14%, Liberia 10%, Brazil 7%, Other 2%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Iron ore	601.24	Free	Free	Free

6. Depletion Allowance: 12.75% (Domestic) and 11.9% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ See also Iron and Steel, and Iron and Steel Scrap.
2/ Usable ore, including byproduct ore.
3/ Figures for 1983 and later are not comparable to data shown for previous years, owing to reclassification of some mine stocks. Adjustments of data for years prior to 1983 are withheld to avoid disclosing company proprietary data.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.

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8. Events, Trends, and Issues: World iron ore production, trade, and consumption increased in 1984, as demand for iron and steel rose moderately. Ocean freight rates increased, but iron ore prices on the international market declined for the second consecutive year owing to abundant supplies of ore and the strength of the U.S. dollar.

In the United States, iron ore production increased by about 35% compared with the depressed levels of the previous 2 years, as demand for iron and steel increased and stocks of ore were low. Exports and imports increased. Published prices for Lake Superior ores were stable, while lake freight rates increased for the first time in 3 years and some rail freight rates increased. The industry continued to face problems of overcapacity and declining markets, although productivity improved. Several mines and one pelletizing plant were closed permanently, and with unusually high imports of steel, demand for ore again began to fall by July, and by yearend, at least five of the eight taconite operations in Minnesota were shut down for indefinite periods and several thousand employees were laid off. Restructuring of mine production capacity and ownership was expected to continue in 1985.

From a 1981 base, demand for iron ore is expected to decline at an average annual rate of about 2% through 1990. It is estimated that in 1985 domestic production of iron ore will be 49 million tons and U.S. apparent consumption will be 65 million tons.

Environmental concerns in the iron ore industry continued to be reclamation and disposal of process water, plant tailings and other solid waste; reduction of dust and noise; and control of groundshock from blasting. Technological research continued on the use of olivine and other fluxes in pellets to improve blast furnace productivity, direct reduction of pellets using solid fuels, and direct smelting of pellets using a plasma-arc process.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/	
	1983	1984 e/	Crude Iron Ore (million long tons)	Iron Content (million short tons)
United States	37.6	51.0	24,800	5,800
Australia	72.8	84.0	33,000	20,200
Brazil	87.6	100.0	15,600	10,800
Canada	33.0	36.0	25,100	9,700
France	15.7	15.0	2,200	900
India	38.2	40.0	7,100	4,800
Liberia	14.7	15.0	1,600	800
South Africa, Republic of	16.3	21.0	9,300	6,600
Sweden	13.0	15.0	4,600	2,400
Venezuela	9.6	12.0	2,000	1,200
Other Market Economy Countries	57.2	60.0	12,100	6,200
China	e/70.0	71.0	9,000	3,500
U.S.S.R.	241.1	242.0	59,000	25,000
Other Centrally Planned Economies	22.8	23.0	900	300
World Total	729.6	785.0	206,300	98,200

10. World Resources: World resources are estimated to exceed 800 billion long tons of crude ore containing more than 260 billion short tons of iron. U.S. resources are estimated at about 108 billion long tons of ore containing about 30 billion short tons of iron. U.S. resources are mainly low-grade taconite-type ores of the Lake Superior district that require beneficiation and agglomeration for commercial use. U.S. resources include economic reserves estimated at approximately 16 billion long tons of ore containing nearly 4 billion short tons of iron recoverable in concentrate.

11. Substitutes: Iron ore is the only source of primary iron. Small amounts of ferrous scrap may be added to blast furnace burdens. Scrap is extensively used in steelmaking and in iron and steel foundries.

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IRON AND STEEL 1/

(Data in million short tons of metal, unless noted)

1. Domestic Production and Use: In 1984, the iron and steel and ferrous foundry industries produced steel mill products and castings valued at about $50 billion. The steel industry was composed of approximately 92 companies producing raw steel in 131 plants. Pig iron was produced by 12 companies owning 100 blast furnaces. Indiana, Ohio, Pennsylvania, Michigan, and Illinois accounted for 70% of total raw steel production. The foundry industry included approximately 1,500 ferrous foundries producing gray, malleable, and ductile iron castings and steel castings. End use distribution of domestic iron and steel consumption in 1984 was estimated as follows: Construction, 31%; transportation, 27%; machinery, 19%; appliances and equipment, 7%; and other, 16%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Pig iron:					
Production	68.7	73.8	43.3	48.8	53.0
Shipments 2/	69.4	74.2	43.4	49.1	53.0
Imports for consumption	0.4	0.5	0.3	0.2	0.2
Exports	0.1	3/	3/	3/	3/
Consumption, reported	69.1	75.0	44.4	50.1	53.0
Price, dollars per ton, Iron Age composite for year	203.00	204.66	213.00	213.00	213.00
Stocks, yearend, total producer and consumer	0.9	0.9	0.6	0.3	0.4
Steel and cast iron:					
Production of raw steel	111.8	120.8	74.6	84.6	93.0
Shipments: Steel mill products	83.9	88.4	61.6	67.6	73.3
Steel castings	1.9	1.8	1.0	0.7	0.9
Iron castings	12.0	12.3	8.5	9.5	10.4
Imports for consumption of major iron and steel products	16.4	20.8	17.4	18.0	26.5
Exports of major iron and steel products	4.7	3.6	2.4	1.6	1.4
Consumption, apparent	112.8	120.3	88.6	92.4	109.5
Price, finished base, cents per pound, Iron Age composite for year	21.7	24.2	25.3	26.2	27.3
Stocks, steel mill products, yearend; consumer and service center 4/	13.9	5/11.3	8.8	10.6	10.8
Employment, average: 6/					
Blast furnaces and steel mills (SIC 3312)	428,000	422,000	325,000	275,000	273,000
Iron and steel foundries (SIC 332)	209,000	201,000	159,000	143,000	150,000
Net import reliance 7/ as a percent of apparent consumption	13	15	20	16	23

3. Recycling: See Iron and Steel Scrap.

4. Import Sources (1980-83): Japan 31%, European Economic Community (EEC) 29%, Canada 14%, Other 26%. Imports from Latin America and the Republic of Korea increased in 1983 and 1984.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Pig iron 8/	606.13	Free	Free	$1.125/long ton
Structural steel	609.80	0.9% ad val.	0.9% ad val.	2% ad val.

6. Depletion Allowance: Not applicable.

e/ Estimated.
1/ See also Iron Ore and Iron and Steel Scrap.
2/ Includes pig iron transferred directly to steel furnaces at same site.
3/ Less than 50,000 tons.
4/ Included producer stocks in earlier editions of Mineral Commodity Summaries.
5/ Revised series beginning 1981.
6/ Bureau of Labor Statistics.
7/ Defined as imports - exports + adjustments for Government and industry stock changes.
8/ Containing less than: Chromium, 0.2%; molybdenum, 0.1%; tungsten, 0.3%; and vanadium, 0.1%.

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7. Government Stockpile: None.

8. Events, Trends, and Issues: Apparent consumption of iron and steel was significantly higher in 1984 than in 1983, but production and shipments of steel were up only moderately because of a record high level of imports. Raw steel production exceeded 80% of capability during the second quarter of the year but dropped below 60% of capability during the third quarter. Steel continued to be sold at a discount from list prices. Although many steel companies returned to profitability in the first half of the year after 2 years of losses, declining sales and price competition resulted in losses or reduced profits in the second half.

The domestic steel industry continued to close older facilities and to restructure. The American Iron and Steel Institute reduced its assessment of U.S. raw steel production capability from 150 million to 134 million short tons per year. One major company reduced its capacity by about 20%. Total employment in the U.S. steel industry increased only slightly despite higher production as the industry eliminated facilities and worked to improve the productivity of its remaining units. The third and fourth largest companies merged and one plant of another company was purchased by its workers. Japanese steel companies made major investments in the U.S. industry including buying one-half interest in one leading U.S. producer. The finishing operation of an integrated steel mill that had closed in 1983 was reopened to roll imported semifinished slabs. Plans for several new electrogalvanizing lines were announced.

Imports of steel from almost all major supplying countries increased sharply in 1984. Weakness in the world market combined with an increase in the value of the U.S. dollar made exporting to the United States attractive. Several countries set voluntary limits on their exports of steel to the United States after the U.S. industry filed unfair trade complaints. The industry requested broad trade protection through quota legislation and through a section 201 case. In the 201 case, the President decided to negotiate with exporting countries to control unfair and restrictive trade practices and to formalize existing voluntary export restrictions. If necessary, the Administration would initiate unfair trade cases without requiring industry to file complaints. A new trade law provided power to enforce such bilateral agreements on the condition that major steel producers reinvest net cash flow from steel operations in steel. The Administration intended the 5-year program to reduce imports of finished steel to about 18.5% of the U.S. market.

Total world production of steel continued to increase in 1984 from a low point in 1982, but remained below earlier levels and below capacity. Japan and the EEC reversed production declines and many developing countries had significant increases. The steel industries in Japan and in Europe consolidated their operations to eliminate excess or inefficient capacity. Some new capacity was planned or under construction in less developed countries.

It is estimated that in 1985 domestic production of raw steel will be 95 million tons and U.S. apparent consumption of iron and steel will be 105 million tons. From a 1981 base, demand for steel is expected to increase at an average annual rate of about 1.1% through 1990.

9. World Pig Iron and Raw Steel Production:

	Pig Iron		Raw Steel	
	1983	1984 e/	1983	1984 e/
United States	48.8	53.0	84.6	93.0
European Economic Community	81.8	92.0	120.6	128.0
Japan	79.8	90.0	107.1	116.0
Other Market Economy Countries	93.3	104.0	134.1	151.0
China	41.2	43.0	44.0	46.0
U.S.S.R.	121.8	122.0	168.7	169.0
Other Centrally Planned Economies	38.4	40.0	65.4	67.0
World Total (Rounded)	505.0	544.0	724.5	770.0

10. World Resources: Not applicable. See Iron Ore.

11. Substitutes: Iron is the least expensive and most widely used metal. In most applications iron and steel compete either with less expensive nonmetallic materials or with more expensive materials having a property advantage. Iron and steel compete with lighter materials such as aluminum and plastics in the motor vehicle industry; with concrete, aluminum, and wood in construction; and with aluminum, glass, plastics, and paper in containers.

January 1985

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IRON AND STEEL SCRAP 1/

(Data in million short tons of metal, unless noted)

1. Domestic Production and Use: Total estimated value of 1984 domestic production (including exports) was $2.9 billion. The steel industry accounted for about 78% of the domestic scrap consumption, using scrap together with pig iron to produce steel products for the construction, transportation, oil and gas, machinery, container, appliance, and other consumer industries. The ferrous castings industry consumed about 21% of the total to produce cast iron and steel products such as motor blocks, pipe, and machinery parts. Relatively small quantities were used for producing ferroalloys, for the precipitation of copper, and by the chemical industry; these uses totaled less than 1 million tons.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Home scrap	42.2	43.8	27.1	27.2	30.1
Purchased scrap 2/	51.5	47.8	34.4	41.3	46.5
Imports for consumption	0.6	0.6	0.5	0.6	0.6
Exports 3/	11.2	6.4	6.9	7.7	8.2
Consumption: Reported	83.7	85.1	56.4	61.8	68.8
Apparent	84.3	85.7	56.8	62.0	69.8
Employment: Dealers, brokers, processors e/	30,000	25,000	24,000	22,500	23,000
Price, average, dollars per gross ton delivered: No. 1 Heavy Melting composite price, Iron Age average: Pittsburgh, Philadelphia, Chicago	91.35	91.33	63.73	72.91	87.00
Stocks: Consumer, yearend	8.0	8.1	6.4	5.8	5.6
Net import reliance 4/ as a percent of apparent consumption			Net exporter		

3. Recycling: All iron and steel scrap is recycled material, consisting of about one-half home scrap, one-fourth prompt industrial scrap, and one-fourth old (obsolete) scrap.

4. Import Sources (1980-83): Canada 83%, Other 17%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Iron and steel waste and scrap:				
Tin plate waste or scrap	606.08	Free	Free	Free
Other				
Not containing over 0.2% Cr, 0.1% Mo, 0.3% W, or 0.1% V	606.09	Free	Free	75¢/long ton
Containing over 0.2% Cr, 0.1% Mo, 0.3% W, or 0.1% V	606.11	Free	Free	0.5% ad val plus additional duties

6. Depletion Allowance: Not applicable.

7. Government Stockpile: None.

e/ Estimated.
1/ See also Iron Ore and Iron and Steel.
2/ Receipts minus shipments by consumers, plus exports minus imports.
3/ Includes rerolling material and ships, boats, and other vessels for scrapping.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.

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8. Events, Trends, and Issues: Some steelmaking and ferrous casting facilities remained idle. Through September 1984, raw steel production at 71.1% of productive capability was 72.1 million tons compared with 61.4 million tons at 54.5% of productive capability in the first 9 months of 1983. In August 1984, total steel shipments for 1984 were projected to be less than 78.0 million tons. The domestic ferrous castings industry in the first 8 months of 1984 shipped 7.58 million tons of all types of iron castings, 23% more than in the same time period in 1983, while the 641,000 tons of steel castings shipments were 47% more than the 333,000 tons shipped in the first 8 months of 1983. On August 31, 1984, stocks of ferrous scrap held by the three major types of domestic consumers were 6.04 million tons, 24,000 tons more than on August 31, 1983. Composite prices quoted by Iron Age on a gross ton delivered basis of No. 1 Heavy Melting steel scrap to domestic purchasers, regarded as the bellwether by the scrap industry, in the first 10 months of 1984 averaged $87.53, ranging from $94.92 in February to $81.90 in July. In the first 10 months of 1983, this grade of scrap averaged $71.48, ranging from $61.30 in January to $77.97 in October.

A comparison of data for the first 7 months of 1984 and 1983 indicates that receipts of ferrous scrap by all domestic consumers from brokers, dealers, and other outside sources in 1984 were 22.7 million tons valued at $1.82 billion ($79 per ton) and 15.5 million tons valued at $1.03 billion ($67 per ton) in 1983.

In the first 7 months of 1984, the delivered cost of ferrous scrap received from brokers, dealers, and other outside sources by steel mills approximated $24 per ton of raw steel produced; manufacturers of steel castings paid approximately $118 per ton of castings shipped; and the iron castings industry paid approximately $58 per ton of castings shipped, excluding ingot molds and stools made using blast furnace hot metal.

Exports of all grades of ferrous scrap in the first 8 months of 1984 totaled 6.24 million tons valued at $593 million ($95.03 per ton) compared with 4.80 million tons valued at $404 million ($84.17 per ton) in the first 8 months of 1983.

Congress in early March 1984, approved new maritime reform legislation giving scrap exporters a tariff-filing exemption formerly given only to bulk-cargoes. Under the new legislation, exporters will be able to negotiate for more advantageous rates, shipping terms and conditions.

The Institute of Scrap Iron and Steel (ISIS) supported legislation in S. 38, that was considered in May 1984, by a House-Senate Conference committee. The legislation excludes dismantlers, who are not engaged in water-borne commerce, from current costly and unnecessary provisions of the Longshoreman's and Harbor Workers Act of April 10, 1984. The President signed this legislation, entitled the Longshore and Harbor Workers' Compensation Amendments of 1984, on September 28, 1984.

It is estimated that in 1985 domestic net receipts of scrap plus exports will total 46 million tons and the U.S. apparent consumption will be 70 million tons. From a 1983 base, demand for ferrous scrap is expected to increase at an average annual rate of approximately 2.8% through 1990.

9. World Mine Production and Reserve Base: Not applicable.

10. World Resources: Not applicable.

11. Substitutes: Approximately 415,000 tons of direct reduced iron, a potential substitute for iron and steel scrap, was used in the United States in 1984.

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IRON AND STEEL SLAG
(Data in thousand short tons)

1. Domestic Production and Use: In 1984, an estimated 20 million tons of iron and steel slags, byproducts of iron and steelmaking, valued at $86 million were sold or used. About 74% of this was iron slag with an f.o.b. value of $70 million, and the balance was steel slag with an f.o.b. value of $16 million. Iron blast furnace slags were processed at 42 facilities in 14 States and consisted of air cooled, expanded, and granulated types. Steel slag, from open hearth, basic oxygen, and electric furnaces, was processed at 47 facilities located in 20 States. About 59% of the Nation's iron and steel slags were produced in Pennsylvania, Indiana, and Ohio. Iron and steel slags were mainly used as construction materials, with iron slag being typically used as road base, fill, concrete aggregate, and asphaltic concrete aggregate, comprising about 42%, 16%, 11%, and 10% of total end use, respectively, and steel slag being mainly used as road base, 43%; fill, 23%; railroad ballast, 11%; and asphaltic concrete aggregate, 10%. Of all iron and steel slag products shipped, 85% traveled by truck with an average marketing range of 23 miles, 8% traveled by rail with an average marketing range of 247 miles, and 3% traveled by waterway with an average marketing range of 540 miles. The remaining 4% was used at plantsite.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Marketable	25,199	21,487	19,516	18,386	20,000
Imports for consumption		Not available 1/			
Exports		Not available 1/			
Consumption, apparent	25,199	21,487	19,516	18,386	20,000
Price, average value, dollars per ton, f.o.b. plant	3.67	3.93	4.07	4.31	4.30
Stocks, yearend		Not available			
Employment, processing plant e/	2,000	1,000	1,000	1,000	1,000
Net import reliance 2/ as a percent of apparent consumption		Not available			

3. Recycling: Before processing, some steel slag is recycled to blast furnaces, directly or as agglomerates, as a source of iron and flux materials. An estimated 3 million tons of steel slag was recycled to the blast furnaces in 1984. Ferrous scrap, recovered from slag during processing, is also recycled to blast and steel furnaces.

4. Import Sources (1980-1983): Not available. 1/ However, minor amounts of granulated blast furnace slag are received from France and Japan for use in the production of high grade cement and blast furnace slag is exported to and imported from Canada periodically. Minor amounts of basic slag were imported and exported for use as artificial fertilizer.

5. Tariff: None.

6. Depletion Allowance: Not applicable.

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Included in blanket Tariff Schedule categories.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.

Prepared by W. I. Spinrad, Jr., telephone number (202) 634-1023

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8. Events, Trends, and Issues: Sales and use of iron and steel slag are expected to grow because of increased production and further demand and usage by construction industries such as highway projects. From a 1983 base, demand for iron and steel slag is expected to increase at an average annual rate of about 3.4% through 1990. It is estimated that in 1985 domestic production and U.S. apparent consumption of iron and steel slag will be 21 million tons.

   Essentially all iron slag produced is used. Most salable iron slag banks in the United States have been worked, so availability of iron slag is largely dependent on current production. However, steel slag banks contain large, undetermined tonnages because of smaller markets. Adverse physical and chemical properties, such as volume change problems because of high lime content, have limited the use of steel slag in many structural applications. Proper selection, processing, aging, and improved technology have broadened steel slag usage, though, and steel slag sales, as a percentage of total slag sales, have increased in recent years. The construction industry continues to be the principal user of iron and steel slag. Besides traditional uses, large increases are expected in the use of granulated blast furnace slag as a replacement for cement because of a savings in the natural resources and energy required to manufacture cement clinker. Also iron slag is being used increasingly in bituminous mixtures and in lightweight concrete applications. Steel slag usage for concrete aggregate is also expected to be a major growth area.

9. World Mine Production and Reserve Base: Not applicable.

10. World Resources: Not applicable.

11. Substitutes: Sand, gravel, and crushed stone for construction materials are the predominant substitutes for iron and steel slags.

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KYANITE AND RELATED MINERALS
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Two firms, in Virginia and Georgia, each with coordinated mining and processing operations, supplied all of the kyanite production. The material was from hard rock open pit mines. Synthetic mullite was produced by five companies in Alabama, Georgia, Kentucky, New York, and Pennsylvania. It was estimated that 90% of the kyanite-mullite output was used in refractories--55% for smelting and processing ferrous metals, 20% for nonferrous metals, and 15% for glassmaking and ceramics. Nonrefractory uses accounted for the balance.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	W	W	W	W	W
Synthetic mullite	40.5	42.0	27.0	e/23.0	27.0
Imports for consumption			Not available		
Exports e/	50.0	45.0	40.0	40.0	43.0
Shipments from Govt. stockpile excesses	0.3	-	-	-	-
Consumption, apparent	W	W	W	W	W

Price: Domestic concentrate, from 35- to 325-mesh sizes, raw bulk, f.o.b. Georgia, $92 to $144 per ton, (bagged material $9 extra); imported kyanite, no current quotation; synthetic mullite, $150 to $1,500 per ton, depending upon type and grade.

Stocks, producer			Not available		
Employment: Kyanite mine and plant e/	200	200	200	200	200
Net import reliance 1/ as a percent of apparent consumption			Net exporter		

3. Recycling: Insignificant.

4. Import Sources (1980-83): Not available after 1977.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Kyanite, sillimanite, andalusite, and dumortierite	523.81	Free	Free	Free
Mullite	523.91	5.6% ad val.	4.9% ad val.	30% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: In addition to quantity shown below, the stockpile contains 1,047 tons of nonstockpile-grade material.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales 11 Months
Kyanite, lump	-	0.1	-	-

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.
3/ Excluding United States and Centrally Planned Economies.

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8. Events, Trends, and Issues: U.S. consumption of kyanite and synthetic mullite was estimated to be slightly higher than in 1983. This was due to an improvement in the iron and steel and nonferrous metal industries in the first part of 1984. From a 1983 base, demand for kyanite/synthetic mullite is expected to increase at an average annual rate of about 2% through 1990. Estimated domestic mine production and U.S. apparent consumption of kyanite/synthetic mullite in 1985 are withheld to avoid disclosing company proprietary data. It is estimated that in 1985 U.S. production of synthetic mullite will be 30,000 tons.

   There has been a trend in recent years toward higher quality refractories, such as those based on kyanite and mullite, resulting in longer furnace lives for these materials. As a result, consumption of refractories in, for example, the iron and steel and other metallurgical industries has decreased.

   Utilization of kyanite/mullite in refractories west of the Mississippi is limited by the expense of shipping the material from the existing production facilities in the East.

   There continues to be a need for research in such areas as improved methods of beneficiation and quality control.

   Environmental regulations covering air, water, and noise continue to be significant factors relative to kyanite-mullite production costs.

9. World Mine Production and Reserve Base:

	Mine Production 1983 e/	Mine Production 1984 e/	Reserve Base 2/
United States	W	W	Large in the United States and the Republic of South Africa; assumed to be large in other countries.
France	33	35	
India	51	50	
South Africa, Republic of	129	135	
Other Market Economy Countries	8	10	
Centrally Planned Economies	NA	NA	
World Total 3/	221	230	

10. World Resources: Immense resources of kyanite and related minerals known to exist in the United States should permit the increase in production needed to meet the demand expected during the next 15 years. The chief resources are in deposits of micaceous schist and gneiss, mostly in the Appalachian area and in Idaho. These resources are not economical at present, but some may be eventually. The characteristics of kyanite resources in the rest of the world are believed to be similar to those in the United States.

11. Substitutes: Two types of synthetic mullite (fused and sintered), superduty fire clays, and high-alumina materials are substitutes for kyanite in refractories. Principal raw materials for both types of synthetic mullite are bauxite, kaolin and other clays, and silica sand.

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LEAD

(Data in thousand metric tons of lead, unless noted)

1. Domestic Production and Use: The value of mine production in 1984, based on the average U.S. producer price, was $187 million. Seven mines in Missouri yielded 87% of the total despite prolonged strikes at six of them. Idaho and Colorado contributed 12%, and the balance was divided among producers in New York, Montana, New Mexico, Illinois, and Arizona. Major coproducts or byproducts were zinc, silver, antimony, and bismuth. Primary lead was smelted and refined at six plants in Missouri, Texas, Montana, and Nebraska. Most of the 35 major plants in the secondary sector operated intermittently during the year. Lead was consumed by approximately 400 firms. Transportation accounted for the major end use with 75% used in batteries, gasoline additives, and other applications. Consumption for construction, ammunition, electrical, TV glass, and paint was 22% of the total, with the balance for ceramics, ballast or weights, tubes or containers, type metal, and other small uses.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine, recoverable content	550	446	512	449	340
Primary refinery	548	498	517	515	400
Secondary refinery	676	641	571	504	550
Imports for consumption: Lead in concentrates	30	27	19	20	30
Metal, including scrap	85	104	100	181	160
Exports: Lead in concentrates	28	33	29	20	10
Metal, including scrap	236	59	87	51	30
Consumption: Reported	1,070	1,167	1,075	1,149	1,125
Apparent	1,001	1,040	1,068	1,043	1,030
Price, average, cents per pound: U.S.	42.5	36.5	25.5	21.7	25
London	41.2	33.3	24.7	19.3	20
Stocks: Metal, producers/consumers, yearend	172	195	165	153	113
Employment: Mine and mill	4,400	3,900	3,500	3,200	2,200
Primary smelters/refineries	1,944	1,400	1,400	1,400	1,100
Secondary smelters/refineries	2,300	2,100	2,000	1,600	1,700
Net import reliance 1/ as a percent of apparent consumption	E	1	3	14	18

3. Recycling: Recovery of lead from old scrap was approximately 500,000 tons.

4. Import Sources (1980-83): Lead in concentrates--Peru 54%, Honduras 27%, Canada 6%, Mexico 2%, Other 11%.
Metal, including scrap--Canada 46%, Mexico 27%, Australia 10%, Peru 5%, Other 12%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Concentrates	602.10	0.75¢/lb, lead content	0.75¢/lb, lead content	1.5¢/lb
Unwrought lead	624.03	3.0% ad val., lead cont.2/	3.0% ad val., lead cont.2/	10.0% ad val.
Waste and scrap	624.04	2.7% ad val., lead cont.	2.3% ad val., lead cont.	11.5% ad val.
Litharge	473.52	3.0% ad val.	3.0% ad val.	12.0% ad val.
Red lead	473.56	3.4% ad val.	3.4% ad val.	12.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

	Stockpile Status--11-30-84			
Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Lead	998	545	-	-

e/ Estimated. E Net exports.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ Total rate not to be less than 1.0625¢/lb.
3/ See page 180 for definitions.

Prepared by W. D. Woodbury, telephone (202) 634-1083.

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8. Events, Trends, and Issues: Refinery capacity utilization in the lead industry during 1984 was 67% in the primary sector but only 44% in the secondary sector due to a pervasive shortage of scrap at acceptable prices. Domestic mine production during the year decreased 24% due to 9-month and 7-month strikes at the nation's two largest primary lead producers, the only fully integrated producers. The six mines and two smelter/refineries affected, all in Missouri, continued to operate at reduced capacities, but the largest smelter/refinery was shut down for 4 months due to lack of feed. A third smelter/refinery in Missouri was struck in October and November. Near record pig lead purchases by the major battery manufacturers in the last quarter of 1983, which were then converted into battery grids and oxide inventories, resulted in reduced metal purchases during 1984.

The U.S. producer and London Metal Exchange prices for lead were 25 and 18 cents per pound, respectively, at the beginning of 1984. The prices rose gradually to about 30 and 22 cents per pound, respectively, through July, but dropped to 22 and 19 cents in October before rising to about 26 and 21 cents later in the year. The prices reflected a generally static worldwide supply-demand balance, responding to seasonal spot shortages only.

It is estimated that in 1985 domestic mine production of lead will be 470,000 tons and U.S. apparent consumption will be 1.0 million tons. From a 1983 base, demand for lead is expected to increase at an average annual rate of about 1.3% through 1990. The growth in lead use is contingent on the development of cost-competitive and reliable electric vehicles for general and new industrial uses, major power supply load-leveling applications, and continuing high growth for uninterrupted power supply systems. In Missouri, development resumed at a major new mine expected to come onstream in late 1985 or 1986.

On July 1, 1984, final effluent limitations under the Clean Water Act became effective for all nonferrous metals and battery manufacturing plants. On August 1, all lead smelters and battery plants were required to submit final compliance plans for the 1979 Occupational Safety and Health Administration lead standard. In August, the Environmental Protection Agency announced that the permissible amount of lead in gasoline will be reduced by over 50% on July 1, 1985, and by over 90% on January 1, 1988, from the present standard. A total ban by 1995 was being considered.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	449	340	27,000
Australia	477	430	28,000
Canada	252	300	17,000
Mexico	182	190	4,000
Morocco	102	100	2,000
Peru	205	200	3,000
South Africa, Republic of	80	80	5,000
Yugoslavia	120	100	5,000
Other Market Economy Countries	600	620	16,000
Centrally Planned Economies	883	890	28,000
World Total	3,350	3,250	135,000

10. World Resources: In recent years significant coproduct reserves of lead have been discovered in Alaska, Canada, Mexico, Australia, and the Republic of South Africa. The identified subeconomic lead resources of the world are estimated at about 1.4 billion tons. Much of this resource is in low-tenor or unconventional deposits that need new technology for development and recovery, but the prospect for finding additional resources of conventional deposits at a rate exceeding consumption is highly favorable.

11. Substitutes: Substitution by plastics has reduced the use of lead in building construction, electrical cable covering, and in cans and containers. Aluminum, tin, iron, and plastics compete with lead in other packaging and protective coatings.

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LIME 1/ 2/
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1984, lime producers at 137 plants in 38 States sold or used 16.1 million tons of lime valued at $853 million, an increase of 8% in tonnage and 13% in value compared with that of 1983. Open-market sales increased 12% to 13.5 million tons. Captive lime used by producers decreased 6% to 2.6 million tons, 64% below the record year of 1971. Ten companies, operating 32 plants, accounted for 52% of the output. Principal producing States were Ohio, Pennsylvania, Missouri, Texas, and Alabama. Each produced over 1 million tons, and together accounted for 47% of the output. The leading individual uses for lime were in steel furnaces, water treatment, construction, sulfur removal from stack gases, and paper and pulp. Dead-burned dolomite was in decreasing demand for refractories. Sales for iron and steel were 38%, environmental uses, 27%; other chemical and industrial uses, 21%; construction, 10%; and refractories and agriculture, 4%. Chemical and industrial sales were up 10%, construction sales increased 9%, refractory sales were up 57%, and sales of lime for agriculture increased 43% compared with 1983.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	19,010	18,856	14,075	14,867	16,100
Imports for consumption	480	504	348	283	240
Exports	42	28	23	28	20
Consumption, apparent	19,448	19,332	14,400	15,122	16,320
Price: Dollars per ton at plant, average	44.34	46.89	49.46	50.96	53.00
Stocks, yearend		Not available			
Employment: Mine and plant	6,500	6,500	5,200	5,300	5,500
Net import reliance 3/ as a percent of apparent consumption	2	2	2	2	1

3. Recycling: Large quantities of lime are regenerated by paper mills, carbide plants, and some municipal water treatment plants. Data for these plants are not included as production, in order to avoid duplication.

4. Import Sources (1980-83): Canada 93%, Mexico 7%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Hydrated	512.11	Free	Free	4/12¢/100 lb
Other	512.14	Free	Free	4/10¢/100 lb

6. Depletion Allowance: 14% (Domestic), 14% (Foreign), for limestone produced and used for lime production.

7. Government Stockpile: None.

e/ Estimated.
1/ Data are for quicklime, hydrated lime, and refractory dead-burned dolomite.
2/ Excludes Puerto Rico, unless noted.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Rates include weight of container.
5/ See page 180 for definitions.
6/ Includes Puerto Rico.

Prepared by J. W. Pressler, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: Sales for environmental uses increased 6% compared with that of 1983. Environmental regulations increased total lime demand for desulfurization of stack gases of thermal powerplants, smelters, refineries, chemical plants, and for neutralizing industrial effluent water and solid wastes to 3.4 million tons. Captive use was down 6%, influenced by the iron and steel industry's trend towards purchases of lime on the open-market, and by the malaise in the copper industry. Two open-market plants in Connecticut and Ohio ceased operations in 1984. Estimated shipments, sold or used, represented 80% utilization of national capacity. From a 1983 base, demand for lime is expected to increase at an average annual rate of about 3.7% through 1990. It is estimated that in 1985 domestic production of lime will be 16.7 million tons and U.S. apparent consumption will be 17.0 million tons.

   The lime industry is energy intensive, averaging about 6.7 million Btu per ton of lime produced in 1983; cost of this energy averaged $13.50 per ton of lime. About 78% of the industry used coal, 14% used natural gas, and 8% used petroleum coke and oil. Natural gas was 50% to 100% more expensive than coal in most areas. Current trends indicate a greater use of coal.

9. World Lime Production and Limestone Reserve Base:

	Production		Reserve Base 5/
	1983	1984 e/	
United States 6/	14,902	16,100	
Belgium	2,200	2,300	
Brazil	5,500	5,700	
Canada	2,344	2,400	
France	3,300	3,400	Adequate for
Germany, Federal Republic of	7,720	8,000	all countries
Italy	2,430	2,500	listed
Japan	8,197	8,500	
Mexico	4,000	4,200	
United Kingdom	3,310	3,400	
Yugoslavia	3,220	3,300	
Other Market Economy Countries	15,142	15,700	
Czechoslovakia	3,420	3,500	
German Democratic Republic	3,860	4,000	
Poland	4,409	4,500	
Romania	4,109	4,300	
U.S.S.R.	28,100	29,000	
Other Centrally Planned Economies	2,984	3,100	
World Total	119,147	123,900	

10. World Resources: Domestic and world resources of limestone and dolomite suitable for lime manufacture are adequate.

11. Substitutes: Limestone is a substitute for lime for many uses such as agriculture, fluxing, and sulfur removal. Although slower to react, limestone is considerably cheaper than calcined energy-intensive lime. Calcined gypsum is an alternate material in industrial plasters and mortars. Cement and lime kiln dust and fly ash are potential resources as substitutes for some construction uses of lime.

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LITHIUM

(Data in short tons of contained lithium, unless noted)

1. Domestic Production and Use: The United States was the world's leading producer and consumer of lithium minerals and compounds. The value of domestic production of lithium compounds was estimated to be about $90 million in 1984. Two companies accounted for all of U.S. production and exported lithium to most of the market economy countries.

   The largest end use for lithium was in aluminum potlines, accounting for an estimated 35% of domestic consumption. Other major applications of lithium were glass and ceramics manufacture and lubricants, which together accounted for approximately 50% of domestic demand.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	W	W	W	W	W
Imports for consumption	90	150	30	35	40
Exports	2,500	2,600	2,300	2,600	2,900
Consumption: Apparent	W	W	W	W	W
Estimated 1/	3,000	3,200	2,000	2,200	2,600
Price, yearend, dollars per pound:					
Lithium carbonate	1.30	1.41	1.41	1.48	1.54
Lithium hydroxide monohydrate	1.72	1.84	1.84	1.93	1.93
Stocks, producer, yearend	W	W	W	W	W
Employment, mine and mill e/	350	375	340	300	300
Net import reliance 2/ as a percent of apparent consumption	Net exporter				

3. Recycling: None.

4. Import Sources (1980-83): China 81%, Federal Republic of Germany 9%, France 4%, Other 6%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Mineral concentrates	523.81	Free	Free	Free
Metal	415.30	8.1% ad val.	6.6% ad val.	25% ad val.
Salts	426.46	5.0% ad val.	5.0% ad val.	25% ad val.
Compounds	419.10	4.0% ad val.	3.7% ad val.	25% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Based primarily on monitoring at the concentrate stage and assuming a 15% lithium loss during conversion of concentrate to chemicals.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.
4/ These estimates denote only an approximate order of magnitude, no basis for more exact estimates is available. Output by China and the U.S.S.R. has never been reported.
5/ Excluding U.S. production.

Prepared by J. E. Ferrell, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: The major world lithium event was the completion and startup of a 14 million-pound-per-year capacity lithium carbonate plant in Chile, which produced about 6 million pounds in 1984. The Chilean plant capacity is about 20% of total U.S. lithium carbonate capacity. The head feed material for the plant comes from subsurface brines located in the Salar de Atacama in northern Chile. The operation is under a limited partnership owned 55% by a U.S. lithium producer and 45% by the Chilean Goverment's development company.

Interest has grown in aluminium-lithium alloys for the aerospace industry as these alloys near the commercial production stage. Ingots ranging from 8,500 to 10,000 pounds have been produced in the United States. In 1985, the new alloys, which contain from 1% to 3% lithium metal, should be commercially available in the United States and France, and perhaps the United Kingdom.

From a 1983 base, demand is expected to increase at an average annual rate of about 5.6% through 1990. It is estimated that in 1985 U.S. consumption of lithium will be 3,200 tons.

9. World Mine Production and Reserve Base:

	Mine Production 1983	Mine Production 1984 e/	Reserve Base 3/
United States	W	W	450,000
Argentina e/	5	5	NA
Australia e/	75	100	350,000
Bolivia	-	-	6,000,000
Brazil	60	60	NA
Canada	-	-	400,000
Chile	-	560	1,500,000
Namibia e/	20	20	NA
Portugal	10	10	NA
Zaire	-	-	350,000
Zimbabwe	150	150	30,000
China 4/	350	350	NA
U.S.S.R. 4/	1,400	1,400	NA
World Total (rounded)	5/2,100	5/2,700	9,100,000

10. World Resources: The identified lithium resources total 0.86 million tons in the United States and 7.2 million tons in the other market economy countries.

11. Substitutes and Alternates: Substitutes for lithium compounds are possible in manufactured glass, ceramics, greases, and batteries. Examples are sodic and potassic fluxes in ceramic and glass manufacture; calcium and aluminum soaps as substitutes for lithium stearates in greases; and zinc, magnesium, calcium, and mercury as anode material in primary batteries. Lithium carbonate can be reduced or excluded in aluminum potlines by increasing the percentages of cryolite, calcium fluoride, and aluminum fluoride.

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MAGNESIUM METAL 1/

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: During 1984 two companies produced magnesium metal by electrolytic methods and a third by the silicothermic method, with metal production valued at over $300 million. One company at Freeport, TX, used seawater as its raw material. Another producer in Rowley, UT, used the brines of the Great Salt Lake. A third produced metal from dolomite mined in Washington by the silicothermic method. Fifty-six percent of the metal was used for the manufacture of aluminum-base alloys. Magnesium castings and wrought products accounted for 18%; reducing agent, 6%; cathodic protection, 7%; manufacture of nodular cast iron, 3%; and other, 10%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Primary	2/170	154	102	115	130
Secondary	40	46	43	46	45
Imports for consumption	4	7	5	6	7
Exports	57	35	40	47	50
Consumption, reported, primary	96	91	75	82	90
Consumption, apparent 3/	129	136	107	117	100
Price, dollars per pound	1.09-1.25	1.25-1.34	1.34	1.34-1.38	1.43-1.48
Stocks, producer and consumer, yearend	49	63	46	28	40
Employment e/	600	600	500	500	500
Net import reliance 4/ as a percent of apparent consumption	Net exporter				

3. Recycling: In 1984, about 25,000 tons of the reported metal consumption was from old scrap.

4. Import Sources (1980-83): Canada 22%, Norway 22%, France 13%, Italy 13%, Other 30%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Unwrought metal	628.55	12.0% ad val.	8.0% ad val.	100% ad val.
Unwrought alloys	628.57	6.7% ad val.	6.5% ad val.	60.5% ad val.
Wrought metal	628.59	5.0¢/lb on Mg content + 2.8% ad val.	4.5¢/lb on Mg content + 2.5% ad val.	40¢/lb on Mg content + 20.0% ad val.

6. Depletion Allowance: Dolomite 14% (Domestic and Foreign); magnesium chloride 5% (Domestic and Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ See also Magnesium Compounds.
2/ Derived from data reported by the International Magnesium Association (IMA) and the Canadian Department of Mines and Natural Resources. Figures are the difference between total North American production reported by the IMA and Canadian production reported by the Canadian Department of Mines and Natural Resources.
3/ Domestic primary metal production plus recovery from old scrap, and net import reliance.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.

Prepared by D. Kramer, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: The quoted price for primary metal ingot was $1.43 per pound during the first-half of 1984; the remainder of the year it was $1.48 per pound. The domestic industry capacity to produce primary metal, 185,000 tons, provides a reliable source of supply to meet U.S. demand, allowing the United States to remain independent of foreign sources of magnesium metal. However, domestic production, following the trend in the economy in 1982 and 1983, was well below domestic production capacity. In 1984, U.S. primary producers restarted idled production facilities in response to increased magnesium demand for use in aluminum alloying, die castings, and for desulfurization in the iron and steel industry. It is estimated that in 1985 the U.S. apparent consumption and production of magnesium metal will increase over that of 1984. From a 1978 base, the demand for magnesium metal is expected to increase at an average annual rate of about 5% through 1990.

9. World Production and Reserve Base:

	Production		Reserve Base 5/
	1983	1984 e/	
United States	115	130	Since domestic magnesium metal production is derived from natural brines and dolomite, the reserve base for this metal is sufficient to supply current and future requirements. To a limited degree the existing natural brines may be considered a renewable resource wherein any magnesium removed by man can be renewed by nature in a short span of time.
Canada	9	9	
France	10	10	
Italy	8	9	
Japan	7	7	
Norway	39	40	
Yugoslavia	4	4	
China	8	8	
U.S.S.R.	91	91	
World Total	291	308	

10. World Resources: Resources from which magnesium metal may be recovered range from large to virtually unlimited and are globally widespread. Resources of dolomite, and magnesium-bearing evaporite minerals are enormous; magnesium-bearing brines are estimated to constitute a resource in billions of tons; and magnesium can be recovered from seawater at places along world coast lines where salinity is highest.

11. Substitutes: Aluminum and zinc may be substituted for magnesium castings and wrought products.

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MAGNESIUM COMPOUNDS 1/

(Data in thousand short tons of magnesium content, unless noted)

1. Domestic Production and Use: Magnesium oxide and other compounds were produced from seawater by six companies in California, Delaware, Florida, and Texas; by three companies from well brines in Michigan; and by two companies from lake brines in Utah. The value of these compounds was about $150 million. Magnesite was mined by one company in Nevada; and olivine by two companies in North Carolina and Washington. Three companies accounted for almost 80% of the magnesia production. Over 80% of the consumption of magnesium compounds was for the production of basic refractories used in high-temperature metallurgical furnaces for making products such as iron and steel. The remainder was used to prepare caustic-calcined and specified magnesias and other magnesium compounds.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	800	761	564	625	650
Imports for consumption	52	51	44	67	65
Exports	65	35	22	17	20
Consumption, apparent	787	777	586	675	695
Stocks: producer, yearend		Not available			
Employment: Plant	1,000	1,000	900	900	850
Net import reliance 2/ as a percent of apparent consumption	E	2	4	7	6

3. Recycling: None.

4. Import Sources (1980-83): Ireland 41%, Greece 21%, Canada 10%, Japan 9%, Other 19%. Canada was a major import source in 1983 only.

5. Tariff: 3/

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude magnesite	522.61	$0.65/ton	Free	$10.50/ton
Caustic-calcined magnesite	522.64	$2.10/ton	$2.10/ton	$21.00/ton
Refractory magnesia (containing under 4% lime)	531.01	0.17¢/lb	0.16¢/lb	0.75¢/lb
Refractory magnesia (containing over 4% lime)	531.04	6.0% ad val.	6.0% ad val.	30.0% ad val.

6. Depletion Allowance: Brucite 10% (Domestic and Foreign); dolomite and magnesium carbonate 14% (Domestic and Foreign); magnesium chloride 5% (Domestic and Foreign); and olivine 22% (Domestic) and 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net Exporter.
1/ See also Magnesium Metal.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Tariffs are based on gross weight.
4/ See page 180 for definitions.
5/ Excluding U.S. production.

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8. Events, Trends, and Issues: It is estimated that in 1985 domestic magnesium compounds production from all sources will be 675,000 tons and U.S. apparent consumption will be 715,000 tons. From a 1978 base, demand for magnesium compounds is expected to increase at an average annual rate of about 1.8% through 1990. It was estimated that in 1984 the magnesium compounds industry operated at almost 70% of capacity.

9. World Production and Reserve Base:

Country	Magnesite Production		Reserve base 4/	
	1983	1984 e/	Magnesite	Well and lake brines and seawater
United States	W	W	10,000	
Australia	9	10	95,000	
Austria	346	350	15,000	
Brazil	63	70	150,000	
Canada	21	25	30,000	
Greece	222	250	30,000	
India	150	150	30,000	
Turkey	242	250	10,000	
Yugoslavia	98	110	5,000	
Other Market Economy Countries	206	210	350,000	
China	634	635	820,000	
Czechoslovakia	213	220	20,000	
Korea, North	588	590	490,000	
U.S.S.R.	692	700	720,000	
Other Centrally Planned Economies	3	5	10,000	
World Total (rounded)	5/3,500	5/3,600	2,800,000	Vast

10. World Resources: Resources from which magnesium compounds may be recovered range from large to virtually unlimited and are globally widespread. Identified world resources of magnesite total 12 billion tons, and of brucite, several million tons. Resources of dolomite, forsterite, and magnesium-bearing evaporite minerals are enormous; magnesia-bearing brines are estimated to constitute a resource in billions of tons; and magnesium hydroxide can be recovered from seawater at places along world coast lines where salinity is highest.

11. Substitutes: Alumina and silica can be substituted for magnesia in some refractories, depending on requirements.

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MANGANESE

(Data in thousand short tons, gross weight, unless noted)

1. Domestic Production and Use: No manganese ore containing 35% or more manganese was domestically produced in 1984. Most manganese ore was consumed by approximately 25 firms with plants located principally in the Eastern and Midwestern United States. A large share of this ore was converted to manganese ferroalloys for use in steel production. Most of the remaining ore was used in producing pig iron and dry cell batteries, and for various chemical purposes. End uses were construction, 23%; transportation, 19%; machinery, 14%; and other, 44%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine 1/			None		
Imports for consumption:					
Manganese ore 2/	698	639	238	368	410
Ferromanganese 3/	606	671	493	342	500
Shipments from Government stockpile excesses: Manganese ore 2/	366	293	62	74	55
Exports: Manganese ore 2/	53	65	29	19	140
Ferromanganese 3/	12	15	10	8	6
Consumption, reported 4/:					
Manganese ore 2/	1,071	1,077	609	531	510
Ferromanganese 3/	789	821	439	446	510
Consumption, apparent, manganese 5/	1,029	1,027	672	668	740
Price, average value: 46-48% Mn metallurgical ore, dollars per L.T.U. cont.) Mn, c.i.f. U.S. ports	1.70	1.72	1.58	1.38	1.43
Stocks, producer and consumer, yearend:					
Manganese ore 2/	1,030	1,036	751	617	550
Ferromanganese 3/	206	202	243	195	150
Net import reliance 6/ as a percent of apparent consumption	98	98	99	99	99

3. Recycling: Scrap recovery specifically for manganese was insignificant. However, considerable manganese was recycled through processing operations as a minor component of ferrous and nonferrous scrap and steelplant slag.

4. Import Sources--United States (1980-83):
   Manganese ore 2/ - Republic of South Africa 31%, Gabon 29%, Australia 17%, Brazil 12%, Other 11%.
   Ferromanganese 3/ - Republic of South Africa 39%, France 30%, Other 31%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	601.27	Free	Free	1¢/lb. of contained Mn
High-carbon ferromanganese	606.30	1.5% ad val.	1.5% ad val.	10.5% ad val.
Metal	632.30	14% ad val.	14% ad val.	20% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated.
1/ Excludes manganiferous ore containing less than 35% manganese, which accounts for about 2% or less of apparent consumption of manganese.
2/ Manganese ore typically ranges from 35% to 54% manganese content.
3/ Ferromanganese typically ranges from 74% to 95% manganese content.
4/ Total manganese consumption cannot be approximated from consumption of manganese ore and ferromanganese because of the use of ore in making manganese ferroalloys and metal.
5/ Thousand short tons, manganese content. Based on estimates of average content for all significant components except imports, for which content is reported.
6/ Defined as imports - exports + adjustments for Government and industry stock changes.
7/ See page 180 for definitions.

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7. Government Stockpile: Data pertain to uncommitted inventories. In addition to those shown below for stockpile-grade material, inventories of nonstockpile-grade material consist of approximately 34,000 tons of natural battery ore, 90 tons of chemical ore, and 943,000 tons of metallurgical ore. The stockpile contains further quantities of chemical ore, natural battery ore, and metallurgical ore that have been sold but not yet shipped. The General Services Administration (GSA) sold nearly all the chemical ore that had been available for sale in FY 1984. As of October 1, GSA's authority to sell manganese materials changed so as to include all nonstockpile-grade natural battery and metallurgical ore in inventory; for metallurgical ore, the authority for disposal was increased by 292,000 tons. GSA had awarded a contract in December 1983, for 48,000 tons of stockpiled metallurgical ore to be upgraded domestically into high-carbon ferromanganese, and in November 1984, awarded a contract for similar upgrading of an additional 80,000 tons of ore.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 months
Battery: Natural ore	62	176	18	6
Synthetic dioxide	25	3	-	-
Chemical ore	170	172	-	20
Metallurgical ore	2,700	2,368	-	-
Ferromanganese: High-carbon	439	600	-	-
Medium-carbon	-	29	-	-
Silicomanganese	-	24	-	-
Electrolytic metal	-	14	-	-

8. Events, Trends, and Issues: Ore production was nearly unchanged overall, having remained quite low in the Republic of South Africa while generally advancing elsewhere. Ore and ferroalloy prices rose marginally, despite overcapacity for both. Developments in Australia and Brazil augured greater future supplies of battery ore.

From a 1983 base, U.S. demand for manganese is expected to follow the raw steel production trend and increase at an average annual rate of about 3% through 1990. It is estimated that in 1985 domestic mine production of manganese ore 1/ will be zero, and U.S. apparent consumption of manganese will be 750,000 tons, content basis. Imports will continue to supply U.S. demand, except as supplemented by deliveries of Government stockpile excesses.

Manganese is an essential element for man and animals that can be harmful when in excess. Thus, manganese can be an industrial poison, but is not a hazard generally. Investigation to date indicates that environmental effects of ocean mining would be insignificant during the exploratory phase and probably during commercial operations as well.

9. World Mine Production and Reserve Base:

	Mine Production 1983	Mine Production 1984 e/	Reserve Base 7/
United States	-	-	-
Australia	1,491	1,800	540,000
Brazil	e/2,300	2,300	180,000
Gabon	2,047	2,300	440,000
India	1,455	1,400	120,000
South Africa, Republic of	3,181	2,700	8,500,000
Other Market Economy Countries	e/860	860	73,000
China	e/1,760	1,800	110,000
U.S.S.R.	e/11,500	11,600	2,500,000
Other Centrally Planned Economies	e/145	140	25,000
World Total (may be rounded)	e/24,700	24,900	12,000,000

10. World Resources: Identified land-based resources are large but are irregularly distributed. The U.S.S.R. and the Republic of South Africa account for more than 80% of the world's identified resources; the Republic of South Africa for more than 75% of those of the market economy countries. Extensive manganese oxide deposits are found on the deep ocean floors, those in the equatorial area of the Pacific Ocean being of particular interest.

11. Substitutes: There is no satisfactory substitute for manganese in its major applications.

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MERCURY

(Data in 76-pound flasks of mercury content, unless noted)

1. Domestic Production and Use: The value of total domestic production, primary and secondary, was estimated at $7.4 million. One company produced mercury from its mine in Nevada and a small amount of mercury was recovered as a byproduct of gold refining. About six companies in the Eastern United States recovered secondary mercury from used instruments, batteries, dental amalgams, industrial scrap and/or residues. About 170 companies, universities, and Government facilities located east of the Mississippi River accounted for an estimated 95% of the Nation's mercury consumption. Uses were electrical, 64%; electrolytic production of chlorine and caustic soda, 14%; paints, 9%; industrial and control instruments, 6%; and other, 7%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine (primary)	30,657	27,904	25,760	25,070	19,100
Secondary	1/16,806	1/11,244	4,473	13,474	4,000
Imports for consumption	9,416	12,408	8,916	12,786	28,000
Exports	Not available				
Shipments from Government stockpile excesses	-	-	2/7,088	6,000	4,500
Consumption: Reported	58,983	59,244	48,943	49,138	54,000
Apparent	51,392	57,286	44,249	55,139	58,100
Price, average value, dollars per flask: New York, dealer	389.45	413.89	370.93	322.44	320.00
London	398.07	417.52	376.96	313.33	310.00
Industry stocks: Mine, consumer and dealer, yearend	33,069	27,339	29,327	31,518	29,000
Employment: Mine and mill, average	46	48	45	45	43
Net import reliance 3/ as a percent of apparent consumption	27	44	31	30	60

3. Recycling: Production from old scrap totaled 4,000 flasks, equivalent to 7% of reported consumption.

4. Import Sources (1980-83): Spain 30%, Japan 25%, Mexico 7%, Turkey 6%, Other 32%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Metal, waste and scrap	632.34	6.2¢/lb	6.4¢/lb	25¢/lb

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: In addition to the data shown below, 35,305 flasks of secondary mercury was held by the U.S. Department of Energy, Oak Ridge, TN.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess To Goal Authorized For Disposal	Sales, 11 Months
Mercury	10,500	174,223	4,800	4,092
Mercuric Oxide	-	435,902 lbs	420,000 lbs	329,100 lbs

e/ Estimated.
1/ Includes sales of surplus mercury from U.S. Department of Energy stocks.
2/ Includes 1,000 pounds of mercuric oxide, equivalent to 12 flasks of mercury metal, at a nominal 91%.
3/ Defined as imports - exports + adjustments for Government and industry stock changes. Export data were not available and were assumed to be zero in the calculation.
4/ See page 180 for definitions.

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8. Events, Trends, and Issues: Domestic mine output in 1984 declined about 24% from that of 1983, in response to the large quantity of secondary mercury produced in 1983. The bulk of the mine output came from one facility located in Nevada.

It is estimated that in 1985 domestic mine production of mercury will be 20,000 flasks and U.S. apparent consumption will be 60,000 flasks. From a 1983 base, demand for mercury is expected to decrease at an average annual rate of less than 1% through 1990.

The average New York dealer price for primary mercury reached a low of $288.26 per flask in February, increased in May to a high of $329.86 per flask, fell through August, and increased in October to $329.14 per flask. The low New York dealer prices during the summer months were a reflection of weak demand, coupled with increased imports of mercury from Algeria and Spain--encouraged by a strong U.S. dollar. Analysts attributed the large price increase in September to purchases for immediate consumption, especially in the electrical industry.

A task force investigation of mercury that was spilled or lost between 1955 and 1963 at the U.S. Department of Energy, Oak Ridge, TN, facility, continued in 1984. The investigation concluded that the total amount of mercury lost or unaccounted for was 2.0 million pounds, or 26,316 flasks, of which 0.7 million pounds, or 9,211 flasks, were known losses to the environment and 1.3 million pounds, or 17,105 flasks, were unaccounted for. Continued sampling, monitoring, and cleanup was planned. The task force concluded that there is no immediate or foreseeable major health risk as a result of the mercury discharges.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1983	1984 e/	
United States	25,070	19,100	200,000
Algeria	10,000	10,000	100,000
Italy	-	-	2,000,000
Mexico	8,000	7,000	250,000
Spain	48,000	50,000	2,700,000
Other Market Economy Countries	9,000	11,000	950,000
U.S.S.R.	64,000	65,000	500,000
Other Centrally Planned Economies	24,400	25,000	500,000
World Total (may be rounded)	188,500	187,100	7,200,000

10. World Resources: World mercury resources are estimated at 17 million flasks, located principally in Spain, the U.S.S.R., Yugoslavia, and Italy. At present production rates, sufficient resources are available for about 90 years.

11. Substitutes: Present and potential mercury substitutes include lithium or nickel-cadmium in batteries; diaphragm and membrane cells in the electrolytic production of chlorine and caustic soda; composite materials for dental fillings; and various compounds in exterior latex paint.

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MICA (NATURAL), SCRAP AND FLAKE 1/
(Data in thousand short tons)

1. Domestic Production and Use: Scrap and flake mica production, excluding low-quality sericite, increased about 7% in 1984. North Carolina accounted for 57% of U.S. production. The remaining output came from Connecticut, Georgia, New Mexico, Pennsylvania, South Carolina, and South Dakota. Scrap mica was recovered principally from mica and sericite schist and from feldspar, kaolin, and lithium beneficiation. The bulk of domestic production was processed into small particle-size mica by wet and dry grinding. Primary uses were joint cement, paint, roofing, oil well drilling, and rubber products. The value of 1984 scrap mica production was $9.0 million. Ground mica sales were valued at $20 million. There were 13 domestic producers of scrap and flake mica. Production of low-quality sericite, used primarily for brick manufacturing, totaled 35,000 tons, valued at $110,000.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production 2/ 3/: Mine	116	133	106	140	150
Ground	111	117	96	130	140
Imports for consumption e/	9	11	8	7	13
Exports e/	14	11	11	10	8
Consumption, apparent 4/	106	117	93	127	145
Price: Average, dollars per ton, reported					
Scrap and flake	45	62	61	46	57
Ground:					
Wet	337	349	419	397	400
Dry	98	119	136	118	120
Stocks: Producer, yearend e/	7	7	7	7	7
Employment: Mine e/	75	75	75	75	75
Net import reliance 5/ as a percent of apparent consumption	E	E	E	E	3

3. Recycling: None.

4. Import Sources (1980-83): Canada 62%, India 33%, Brazil 3%, Other 2%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Phlogopite, untrimmed	516.11	Free	Free	15.0% ad val.
Phlogopite, waste and scrap valued under 5¢/lb	516.21	4.7% ad val.	4.2% ad val.	25.0% ad val.
Other waste and scrap valued under 5¢/lb	516.24	2.4% ad val.	2.4% ad val.	25.0% ad val.
Other mica, unmanufactured	516.41	Free	Free	4¢/lb
Ground or pulverized	516.81	3.3% ad val.	2.4% ad val.	20.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net exports.
1/ See also Mica (Natural), Sheet.
2/ Sold or used by producing companies.
3/ Excludes low-quality sericite used primarily for brick manufacturing.
4/ Based on ground mica.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 180 for definitions.

Prepared by L. L. Davis, telephone number (202) 634-1184.

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8. Events, Trends, and Issues: The United States remained the major producer of scrap and flake mica, but became a net importer in 1984. Imports of scrap and flake mica increased significantly in 1984, reflecting increased demand for imported high-quality scrap used to make mica paper. Exports decreased, probably because of increased domestic demand and decreased demand in other countries where economic recovery has lagged behind that of the United States. It is estimated that in 1985 domestic mine production of scrap and flake mica will be 150,000 tons and U.S. apparent consumption of ground mica will be 145,000 tons. From a 1983 base, demand for scrap and flake mica is expected to increase at an average annual rate of about 1.0% through 1990.

   The principal environmental impact of mica mining was the land disturbance commonly associated with surface mining.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 6/
	1983	1984 e/	
United States	140	150	Large
Brazil	2	2	Large
India	14	16	Large
Other Market Economy Countries	35	35	Moderate
Centrally Planned Economies	70	70	Large
World Total	261	273	Large

10. World Resources: Resources of scrap and flake mica are available in granite, pegmatite, schist, and clay deposits and are considered more than adequate to meet anticipated world demand in the foreseeable future.

11. Substitutes: Some of the lightweight aggregates such as diatomite, vermiculite, and perlite may be substituted for ground mica when used as a filler. Ground synthetic fluorophlogopite, a fluorine-rich mica, may replace natural ground mica for uses that require the thermal and electrical properties of mica.

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MICA (NATURAL), SHEET 1/
(Data in thousand pounds)

1. Domestic Production and Use: A minor amount of sheet mica, estimated at less than 500 pounds, was produced in North Carolina in 1984. The domestic consuming industry was dependent upon imports and shipments of Government stockpile excesses to meet demand. During 1984, an estimated 2.3 million pounds of sheet mica valued at $2.5 million was consumed primarily in the manufacture of electrical and electronic equipment.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine e/	NA	2/	2/	2/	2/
Imports for consumption	5,844	4,172	3,897	2,634	2,200
Exports e/	2,411	1,724	1,648	1,210	1,200
Shipments from Govt. stockpile excesses	3,295	995	844	256	1,500
Consumption, apparent	4,543	4,554	2,737	2,207	2,274
Price: Average, dollars per pound, muscovite mica, reported					
Block	12.70	9.34	15.50	13.06	13.00
Film	4.54	4.56	5.36	5.18	5.00
Splittings	0.60	0.61	0.69	0.60	0.60
Stocks: Fabricator and trader, yearend e/	5,356	4,245	4,601	4,074	4,300
Employment: Mine			None		
Net import reliance 3/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None

4. Import Sources (1980-83): India 79%, Belgium 8%, France 4%, Other 9%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Phlogopite, untrimmed	516.11	Free	Free	15% ad val.
Split block	516.31	Free	Free	Free
Other mica, unmanufactured	516.41	Free	Free	4¢/lb
Splittings	516.51	Free	Free	Free
Film not cut/stamped	516.61	Free	Free	Free
Film cut/stamped	516.71	4.4% ad val.	4.4% ad val.	45% ad val.
Block cut/stamped, not perforated, indented	516.73	5% ad val.	5% ad val.	40% ad val.
Block cut, other forms	516.74	8% ad val.	8% ad val.	40% ad val.
Block cut, perforated, indented	516.76	5% ad val.	5% ad val.	40% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. NA Not available.
1/ See also Mica (Natural), Scrap and Flake.
2/ Less than 1/2 unit.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.
5/ Exports and domestic consumption.

Prepared by L. L. Davis, telephone number (202) 634-1184.

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7. Government Stockpile: The General Services Administration continued to dispose of excess splittings. In addition to the quantities shown below, the stockpile contains the following nonstockpile-grade material: 207,000 pounds, muscovite block, stained or better; 640 pounds, muscovite film, 1st and 2nd qualities; 114,000 pounds, phlogopite block; and 181,000 pounds of muscovite block, stained or lower.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Block: Muscovite	6,200	5,006	-	-
Phlogopite	210	17	-	-
Film: Muscovite	90	1,179	1,000	42
Splittings: Muscovite	12,630	15,650	998	1,937
Phlogopite	930	1,519	-	154

8. Events, Trends, and Issues: The small quantity of sheet mica produced in the United States in the last several years was insignificant with respect to its demand. It is estimated that in 1985 domestic mine production of sheet mica will be less than 500 pounds and U.S. apparent consumption will be 2 million pounds. Consumption has fluctuated considerably, but with a downward trend since 1960. The decline in demand has been caused by price increases, problems of obtaining quality supplies promptly, the increase in solid state technology, the availability of mica-based and nonmica-based substitutes, and imports of finished mica products from foreign sources. From a 1983 base, demand for sheet mica is expected to decline at an average annual rate of about 3% per year through 1990. There were no environmental problems associated with the manufacture of mica products.

9. World Mine Production and Reserve Base:

	Mine Production 1983	Mine Production 1984 e/	Reserve Base 4/
	2/	2/	
United States			Small
Brazil	300	300	Large
India	5/12,000	5/12,000	Very large
Madagascar	600	600	Large
Other Market Economy Countries	400	400	Moderate
Centrally Planned Economies	400	400	Large
World Total	13,700	13,700	Large

10. World Resources: There has been no formal evaluation of world resources of sheet mica because of the sporadic occurrence of this material. Large deposits of mica-bearing rock are known to exist in countries such as India, Brazil, and Madagascar. Limited resources of sheet mica are available in the United States. These domestic resources are uneconomic because of the high cost of hand labor required to mine and process the sheet mica.

11. Substitutes: There are many mica substitutes for sheet mica that have gained acceptance by the industry. These include built-up mica, reconstituted mica (mica paper), and glass-bonded and phosphate-bonded micas.

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MOLYBDENUM

(Data in thousand pounds of molybdenum content, unless noted)

1. Domestic Production and Use: In 1984, molybdenum valued at about $337 million (based on average oxide price) was produced by 13 firms. Four firms in Colorado, Idaho, Nevada and New Mexico mined molybdenum ore. Nine firms in Arizona, California, and Utah recovered molybdenum as a byproduct or coproduct from copper, tungsten, and uranium ore. Five plants converted molybdenite (MoS_2) concentrate to molybdic oxide (MoO_3) from which intermediate products such as ferromolybdenum, metal powder, and various chemicals were produced. Iron and steel producers accounted for about 75% of the molybdenum consumed. Major end use applications were as follows: Machinery, 35%; oil and gas industry, 20%; transportation, 15%; chemicals, 15%; electrical, 10%, and other, 5%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	150,686	139,900	84,381	33,951	99,000
Imports for consumption, concentrate	1,825	1,988	3,115	1,121	50
Exports, molybdenite concentrate and oxide	68,217	51,350	49,783	47,068	54,000
Consumption: Reported	53,265	50,189	27,665	27,225	33,000
Apparent	60,754	61,103	31,000	36,000	40,000
Price: Average value, dollars per pound of concentrate 1/	9.70	8.50	4.00	3.65	3.40
Stock: Mine and mill concentrate, yearend	18,101	35,043	38,510	11,637	17,000
Other, producer and consumer, yearend	34,423	50,726	53,583	31,997	32,000
Employment: Mine and mill, molybdenum major product	6,300	5,500	1,500	2,500	3,600
Net import reliance 2/ as a percent of apparent consumption	E	E	E	3/ 7	E

3. Recycling: Some secondary molybdenum in the form of metal or superalloys was recovered, but the amount was small. An indeterminate quantity of molybdenum was reclaimed from spent catalysts. Although some molybdenum was recycled as a minor constituent of scrap alloy steels and iron, the use of such scrap did not generally depend on its molybdenum content.

4. Import Sources (1980-83): Canada 65%, Mexico 15%, Other 20%.

5. Tariff:

Item	Number	Most Favored Nations (MFN) 1/1/85	Most Favored Nations (MFN) 1/1/87	Non-MFN 1/1/85
Concentrate, molybdenum content	601.33	9.8¢/lb.	9.0¢/lb.	31.5¢/lb.
Ferromolybdenum, molybdenum content	606.31	5.2% ad val.	4.5% ad val.	31.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net exports.
1/ Major producer price per pound of molybdenum contained in technical-grade molybdic oxide.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Unusually large decreases in domestic stocks resulted in a positive net import reliance as a percent of apparent consumption.
4/ See page 180 for definitions.

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8. Events, Trends, and Issues: The 1984 molybdenum market reflected continuing over-supply conditions. The surplus conditions restrained the recovery of the market.

U.S. mine output of molybdenum in 1984 increased 192% when compared with that of 1983. The large increase was due to reopening of mines that had been shut down in 1983. Compared with the 1983 level, apparent demand increased by about 25%, and exports of molybdenum in concentrate and oxide increased by about 15%. U.S. producer inventories increased by 44% when compared with that of 1983.

As a result of a soft market, the domestic price for technical-grade molybdic oxide averaged $3.40 per pound of contained molybdenum during 1984. Mine capacity utilization for 1984 was 46%.

It is estimated that in 1985 domestic mine production of molybdenum will be 110 million pounds and U.S. apparent consumption will be 45 million pounds. From a 1983 base, U.S. demand for molybdenum is expected to increase at an average annual rate of 0.8% through 1990. Foreign demand should increase at a higher rate, 3.3%. Exports from the United States will continue to supply a large share of world demand.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1983	1984 e/	
United States	33,951	99,000	11,800,000
Canada (shipments)	23,100	18,100	2,000,000
Chile	33,100	35,300	5,400,000
Mexico	11,700	13,300	500,000
Peru	5,800	7,000	500,000
Other Market Economy Countries	1,180	1,300	580,000
Centrally Planned Economies	28,700	30,000	5,170,000
World Total (may be rounded)	138,000	204,000	25,950,000

10. World Resources: Identified resources amount to about 19 billion pounds of molybdenum in the United States and about 46 billion pounds in the world. Molybdenum occurs both as the principal metal sulfide in large low-grade porphyry molybdenum deposits and as a subsidiary metal sulfide in low-grade porphyry copper deposits. Resources of molybdenum are adequate to supply world needs for the foreseeable future.

11. Substitutes: There is little substitution for molybdenum in its major applications as an alloying element in steels, cast irons, and nonferrous metals. In fact, because of its availability and versatility, industry has sought to develop new materials which benefit from the alloying properties of molybdenum. Potential substitutes for molybdenum include chromium, vanadium, columbium, and boron in alloy steels; tungsten in tool steels; graphite, tungsten, and tantalum for refractory materials in high temperature electric furnaces; and chrome-orange, cadmium-red, and organic-orange pigments for molybdenum orange.

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NICKEL

(Data in short tons of nickel content, unless noted)

1. Domestic Production and Use: One firm in Oregon mined nickel ore and produced ferronickel valued at $32 million. Another firm in Louisiana produced nickel metal from imported matte. Nickel was also produced from secondary sources and as a byproduct of copper refining. Secondary nickel was recovered from nickel-bearing alloys, stainless and alloy steel, and residues at copper smelters and refineries, foundries, and steel mills. One facility converted stainless steel plant particulate wastes and spent catalysts to nickel-bearing pigs for use in making stainless steel. Major consumers totaled about 200. The largest were located in Pennsylvania, West Virginia, Ohio, Illinois, Michigan, Maryland, and New York. Major consumption occurred in the production of stainless and alloy steel, 44%; nonferrous alloys, 34%; and electroplating, 18%. Ultimate major end uses were: Transportation, 24%; chemical industry, 16%; electrical equipment, 11%; construction, 10%; fabricated metal products, 9%; petroleum and household appliances, 8% each; and machinery and other, 7% each.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine 1/	14,653	12,099	3,203	-	7,500
Plant: Refined metal:					
From domestic ore 2/	11,225	10,305	3,456	W	8,000
From foreign matte	33,000	38,500	41,500	33,400	34,000
Secondary	49,291	52,000	43,000	51,000	50,000
Imports for consumption	189,188	209,008	129,787	152,333	200,000
Exports, primary forms	19,463	19,616	37,356	23,359	29,000
Consumption: Reported, excludes most secondary	156,299	144,851	103,981	127,845	150,000
Apparent, includes secondary	206,000	206,000	181,000	204,000	225,000
Price, average, dollars per pound:					
Metal f.o.b. Port Colborne, Ont.	3.41	3.43	3.20	XX	XX
Free market, N.Y.	2.85	2.67	2.24	2.20	2.25
Stocks: Consumer, yearend 3/	49,028	22,508	18,853	20,448	26,000
Producer, yearend 4/	60,000	100,000	62,000	36,000	34,000
Employment: Mine e/	160	160	160	160	160
Smelter e/	230	230	230	230	230
Net import reliance 5/ as a percent of apparent consumption	76	75	76	75	74

3. Recycling: Of the 50,000 tons of nickel in scrap consumed in 1984, 50% was estimated as prompt industrial and 50% as obsolete.

4. Import Sources (1980-83): Canada 38%, Australia 13%, Norway 10%, Botswana 10%, Other, 29%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Nickel ore and concentrates	601.36	Free	Free	Free
Nickel oxide	419.72	Free	Free	Free
Ferronickel	606.20	Free	Free	3¢/lb.
Unwrought nickel	620.03	Free	Free	3¢/lb.
Waste and scrap	620.04	Free	Free	3¢/lb.
Nickel flakes	620.30	1.9¢/lb.	Free	14¢/lb.
Nickel powders	620.32	Free	Free	3¢/lb.
Other, over 10% nickel	603.60	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. W Withheld to avoid disclosing company proprietary data. XX Not applicable.
1/ Excludes byproduct nickel from primary copper operations.
2/ Includes byproduct nickel from primary copper operations.
3/ Includes stocks held by the U.S. Mint prior to October 1981, when 32,209 tons of nickel was transferred to the National Defense Stockpile.
4/ Stocks of producers or producers' agents, held in the United States only.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 180 for definitions.

Prepared by P. G. Chamberlain, telephone number (202) 634-1025.

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7. Government Stockpile: In addition to the inventory shown below, in September the General Services Administration (GSA) announced that two companies were awarded contracts totaling 5,000 tons of vacuum-grade nickel for delivery to the National Stockpile in 1985. This was the first GSA purchase of nickel since 1960.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Nickel	200,000	32,209	-	-

8. Events, Trends, and Issues: Domestic primary nickel consumption increased 17% over that of 1983, the second consecutive annual increase, indicating the strength of recovery from the low point of 1982. Producer stocks did not change significantly from those of yearend 1983, and Canada remained the principal source of imports. From a 1983 base, demand for primary nickel is expected to increase at an average annual rate of about 2.5% through 1990. It is estimated that in 1985 domestic mine production of nickel in ore will be 10,000 tons and U.S. apparent consumption will be 230,000 tons. In 1984, mine production rose significantly over that of 1983 because the single U.S. nickel mine in Riddle, OR, was closed throughout 1983 and resumed production early in the year. The principal impediment to greater domestic production was low-grade ore and relatively poor market conditions as reflected by low prices. Energy costs were also a factor.

A Nickel Development Institute was formed in Toronto in late May. Functions of the group will be promotion and development of new and existing market areas, improvement of application technologies, new products, and the discovery and dissemination of basic information for nickel applications. In other developments, a Philippine company resumed production at its Nonoc refinery in June after a 6-month shutdown and operated at about one-quarter of capacity through yearend. Two Philippine banks assumed full control of the company in September. In April, a major Canadian producer announced a significant realignment of its product mix. Electrolytic nickel production was discontinued at the company's Port Colborne, Ontario, refinery, while pellet production at Copper Cliff, Ontario, was increased. In Yugoslavia, the Kavadarci ferronickel smelter closed in March because of power supply problems and lower than expected nickel content of the ore feed.

9. World Mine Production and Reserve Base:

	Mine Production 1983	Mine Production 1984 e/	Reserve Base 6/
United States	-	7,500	2,800,000
Australia	99,200	110,000	5,300,000
Botswana	19,300	20,000	500,000
Canada	134,300	148,000	14,800,000
Indonesia	51,400	52,000	5,800,000
New Caledonia	69,400	45,000	17,000,000
Philippines	20,900	10,000	5,100,000
South Africa, Republic of	22,600	23,000	2,900,000
Other Market Economy Countries	80,972	85,000	19,900,000
Cuba	41,170	42,000	25,000,000
U.S.S.R.	187,000	190,000	8,100,000
Other Centrally Planned Economies	33,100	35,000	4,000,000
World Total (may be rounded)	759,342	768,000	111,000,000

10. World Resources: Identified world resources in deposits averaging approximately 1% nickel or greater contain 143 million tons of nickel. About 80% of the nickel is in laterites and 20% is in sulfide deposits. World resources of lower grade nickel deposits are very large. In addition, there are extensive deepsea resources of nickel in manganese nodules covering large areas of ocean floor, particularly in the Pacific Ocean.

11. Substitutes: With few exceptions, substitutes for nickel would result in increased cost or some sacrifice in the economy or performance of the product. Present and potential nickel substitutes include aluminum, coated steel, and plastics in the construction and transportation industries; nickel-free specialty steels in the power generating, petrochemical, and petroleum industries; titanium and plastics in severe corrosive applications; and platinum, cobalt, and copper in catalytic uses.

January 1985

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NITROGEN (FIXED)--AMMONIA

(Data in thousand short tons of nitrogen, unless noted)

1. Domestic Production and Use: The average f.o.b. value of ammonia produced in the United States in 1984 was estimated to be $1.8 billion. Ammonia was produced by 58 plants owned by 45 firms, primarily by the steam reformation of natural gas. With few exceptions, ammonia manufacture is totally dependent on expensive fossil fuels. Approximately 80% of the ammonia produced was used as fertilizers that include anhydrous ammonia, urea, ammonium phosphate, ammonium nitrate, and other nitrogen compounds. Ammonia also was used to produce plastics, fibers, and resins, 10%; explosives, 4%; and numerous other chemicals, 6%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Ammonia					
Production	16,244	15,655	12,968	11,246	12,800
Imports for consumption	1,921	1,719	1,737	2,169	2,500
Exports	681	506	610	298	350
Consumption, apparent	17,665	16,390	14,084	13,668	14,870
Stocks, producer, yearend	1,483	1,960	1,970	1,422	1,500
Price, dollars per short ton, yearend, quoted f.o.b. gulf coast 1/	120-125	132	120	175	165
Employment, plant	4,500	4,000	3,000	3,000	3,200
Net import reliance 2/ as a percent of apparent consumption	9	5	8	18	14

3. Recycling: None.

4. Import Sources (1980-83): Ammonia: U.S.S.R. 34%, Canada 26%, Mexico 21%, Trinidad and Tobago 16%, Other 3%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ammonia, fertilizer	480.6540	Free	Free	Free
Ammonia, chemical	417.2200	3.8% ad val.	2.8% ad val.	28% ad val.

6. Depletion Allowance: Not applicable.

7. Government Stockpile: None.

e/ Estimated.
1/ Source: Green Markets.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.

Prepared by C. L. Davis, telephone number (202) 634-1190.

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8. Events, Trends, and Issues: Nitrogen fertilizer manufacture is the most capital and energy intensive branch of the chemical fertilizer industry. This fact has inhibited capacity expansions and motivated importation of ammonia from sources with low-cost natural gas feedstock. Nitrogen imports are expected to increase in the future, and some domestic producers are hoping for protective legislation. Low-cost natural gas available in other countries prompted several domestic companies to build ammonia plants outside the United States to supply U.S. and other markets. Natural gas price deregulation, foreign competition, and the increased costs of renegotiated natural gas contracts had forced more than 5 million tons of U.S. ammonia capacity to close permanently or become idle in 1981. However, in 1984 some plants resumed operations and several revamped to reduce energy consumption in an attempt to adjust to major market changes.

Prices of ammonia decreased from a monthly high of $201 in January 1984 to a monthly low in June of $143 per ton, f.o.b. gulf coast, compared with a monthly low of $115 in 1983. The highest monthly f.o.b. gulf coast ammonia price in 1983 was $180. From a 1983 base, demand for ammonia is expected to increase at an average annual rate of about 2.2% through 1990. It is estimated that in 1985 domestic production of ammonia will be 13 million tons and U.S. apparent consumption will be 15 million tons.

The Natural Gas Policy Act of 1978 contains a decontrol provision based on a system of incremental price increases until 1985, when price controls on much of the natural gas are scheduled to be lifted. The act provides that essential agricultural uses of natural gas, including ammonia production, will receive priority second only to residential, school, and hospital use in the event of curtailments.

9. World Production and Reserve Base:

	Plant Production		Reserve Base 3/
Ammonia	1983	1984 e/	
United States	11,246	12,800	Large
Canada	2,617	2,700	"
France	2,200	2,200	"
Germany, Federal Republic of	1,877	1,900	"
India	3,500	3,500	"
Italy	1,169	1,200	"
Japan	1,700	1,700	"
Mexico	2,133	2,200	"
Netherlands	1,922	2,000	"
United Kingdom	1,870	1,900	"
Other Market Economy Countries	14,000	14,000	"
Centrally Planned Economies	41,208	42,000	"
World Total (may be rounded)	85,442	88,000	

10. World Resources: The availability of nitrogen from the atmosphere for fixed nitrogen production is unlimited. Hydrogen required for ammonia production is most commonly obtained from natural gas and by gasification of solid and liquid fuels. Natural gas is widely used to manufacture ammonia because of the comparable favorable costs with solid or liquid fuels. Natural nitrogen compounds occur in the Atacama Desert of Chile, where an estimated 2.5 billion tons of ore are above a cutoff of 7% sodium nitrate. The balance of the Atacama Desert resource may be as large as 25 billion tons.

11. Substitutes: Nitrogen is an essential fertilizer element which has no substitute. There are no economic substitutes for fixed nitrogen explosives and blasting agents in conventional uses. Specific substitutes are available for plastics, fibers, and synthetics but with changes in product characteristics.

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PEAT

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The estimated value of U.S. production of peat for agricultural use in 1984 was about $19.1 million. Domestic production increased about 2%, imports increased about 5%, and apparent demand increased about 3% compared with that of 1983. There were 77 producers with 92 active operations in 22 States. The five principal peat producing States, Michigan, Florida, Illinois, Indiana, and Colorado, accounted for about 75% of U.S. production.

   The demand for packaged peat increased slightly. In 1984, packaged peat totaled 69% of U.S. peat sales, and was used primarily for soil improvement and potting soil. Peat sold in bulk totaled 31% of U.S. peat sales and was used primarily for soil improvement, potting soils, nurseries, and golf courses.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	785	686	798	704	720
Commercial sales	788	757	769	725	740
Imports for consumption	402	342	370	419	440
Exports			None		
Consumption, apparent	1,207	1,089	1,080	1,042	1,168
Price, average value, dollars per ton	20.54	24.82	21.94	25.73	26.50
Stocks, producer, yearend	330	269	357	438	430
Employment, mine and plant	790	770	700	670	700
Net import reliance 1/ as a percent of apparent consumption	35	37	26	32	38

3. Recycling: None.

4. Import Sources (1980-83): Canada, more than 99%; Federal Republic of Germany, less than 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Peat moss, poultry grade	192.5000	Free	Free	50¢ per long ton
Peat moss, fertilizer grade	480.8060	Free	Free	Free

6. Depletion Allowance: 5% (Domestic).

7. Government Stockpile: None.

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.
3/ Includes other centrally planned economies.

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8. Events, Trends, and Issues: Boiler test burns fueled by peat were conducted at a power plant near Virginia, MN. The test was designed to evaluate the burn and identify any technical problems. The burn procedure required varying the peat to coal ratio from 10% to a maximum of 40% peat.

The Minnesota and Michigan State Legislatures passed laws related to peat mining in each State. A subsidiary of a Swedish firm may be the first company to launch a large peat-to-energy project in Minnesota. The firm uses a specially designed sodding machine that scoops wet peat from the bog and extrudes it into log-shaped sods, and about 10,000 tons of these peat logs were produced in 1984. Minnesota's Governor strongly supported the peat project with hopes of starting a new major industry in the State. The State's Department of Energy had several programs for energy development and for conversion of boilers to burn peat fuel. Two Minnesota counties converted heating plants in public buildings to burn peat fuel.

Peat producers in a few States changed their mining methods in response to environmentalists' pressures and State environmental protection organization's regulations. The issues were centered around protection of water quality, unique bog features, and rare plants and animal species.

Canadian sphagnum moss peat comprised 99% of imports. Compared with that of 1983, peat imports increased 5% and prices increased about 3%.

From a 1983 base, demand for peat is expected to increase at an average annual rate of about 3.35% through 1990. It is estimated that in 1985 domestic production of peat will be 750,000 tons and U.S. apparent consumption will be 1.2 million tons.

9. World Mine Production and Reserves:

	Production		Reserve Base 2/
	1983	1984 e/	
United States	704	720	7,000,000
Canada	600	600	10,000,000
Finland	5,610	5,600	7,000,000
Germany, Federal Republic of	2,330	2,400	500,000
Ireland	5,955	6,000	200,000
Other Market Economy Countries	1,015	1,100	5,000,000
U.S.S.R.	397,000	400,000	3/20,000,000
Other Centrally Planned Economies	297	300	---
World Total (rounded)	413,500	417,000	50,000,000

10. World Resources: World resources of peat are estimated at 2.4 trillion tons, of which the U.S.S.R. and Canada each have about one-third. Domestic deposits of peat occur in all 50 States, with estimated resources of about 340 billion tons, or about 14% of the world total.

11. Substitutes: Straw, tree bark, and other fibrous plant materials can be used as a mulch, and, in some instances, substituted for peat as a soil additive in agriculture. The superior water-holding capacity of peat limits this substitution.

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PERLITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The estimated value, f.o.b. mine, of processed perlite produced in 1984 was $16.4 million. Crude ore production came from 13 mines operated by 11 companies in 7 Western States. The leading five companies supplied 91% of production. New Mexico, with 86% of the U.S. crude ore mined, continued to be the major producing State. Processed ore was expanded by 42 companies at 68 plants in 33 States. The principal end uses were building construction products, 69%, and filter aid, 17%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine 1/	638	591	506	474	500
Imports for consumption	-	-	16	36	40
Exports e/	-	-	20	17	20
Consumption, apparent	638	591	502	493	520
Price: Average value, dollars per ton, f.o.b. mine	25.86	29.47	31.71	33.05	33.00
Stocks, producer, yearend		Not available			
Employment: Mine and mill	185	160	150	150	150
Net import reliance 2/ as a percent of apparent consumption	E	E	E	4	4

3. Recycling: None.

4. Import Sources (1980-83): Greece, 100%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude mineral substances, not specifically provided for	523.81	Free	Free	Free

6. Depletion Allowance: 10% (Domestic), 10% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net exports.
1/ Processed perlite sold and used by producers.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.

Prepared by A. C. Meisinger, telephone number (202) 634-1184.

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8. Events, Trends, and Issues: From a 1983 base, demand for perlite is expected to increase at an average annual rate of about 3% through 1990. The supply of perlite from domestic reserves is expected to adequately meet requirements. It is estimated that in 1985 domestic production of processed perlite will be 520,000 tons and apparent consumption will be 540,000 tons.

   Perlite mining has the normal problems of disposal of overburden and the ultimate condition of the abandoned pit sites, but overall it results in a relatively small area of disturbed surface. Mining generally occurred in remote areas and environmental problems were not severe.

9. World Processed Perlite Production and Crude Ore Reserve Base:

	Production		Reserve Base 3/
	1983	1984 e/	
United States	474	500	200,000
Greece	150	200	300,000
Other Market Economy Countries	332	300	500,000
Centrally Planned Economies	544	600	1,000,000
World Total	1,500	1,600	2,000,000

10. World Resources: Very little information is available in perlite-producing countries to estimate resources with any reliability.

11. Substitutes: Alternate materials can be substituted for all uses of perlite, if necessary. Long-established competitive commodities include vermiculite, pumice, slag, diatomite, and expanded clay and shale.

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PHOSPHATE ROCK

(Data in thousand metric tons, unless noted)

1. Domestic Production and Use: Marketable phosphate rock was produced by 22 companies and the estimated value was $1.2 billion. Twelve companies in Florida and 1 in North Carolina produced 87% of the phosphate rock. Companies producing phosphate rock in Idaho, Utah, and Montana reported 10% of the total production. Production in Tennessee was about 3% of the total. The principal domestic markets for phosphate rock were fertilizer, 90%; and chemicals manufactured from either elemental phosphorus or refined wet process phosphoric acid, 10%. About 25% of the phosphate rock produced was exported and 30% was processed into chemicals and fertilizers for export. The major byproducts were fluosilicic acid, vanadium, and uranium.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Marketable	54,415	53,624	37,414	42,573	49,000
Sold or used by producers	54,581	45,526	38,571	46,839	52,000
Imports for consumption	486	13	31	9	10
Exports	14,276	10,395	9,842	12,010	12,200
Consumption 1/	40,791	35,144	28,760	34,840	39,810
Price, average value, dollars per ton, f.o.b. mine 2/	22.78	26.63	25.50	23.97	24.00
Stocks, producer, yearend	13,709	20,200	18,287	14,600	13,000
Employment (mine and beneficiation plant)	9,500	10,000	8,000	7,500	6,500
Net import reliance 3/ as a percent of apparent consumption		Net exporter			

3. Recycling: None.

4. Import Sources (1980-83): Morocco 90%, Mexico 6%, Netherlands Antilles 4%. Imports of phosphate rock from Morocco ceased in 1980.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Phosphates, crude and apatite	480.45	Free	Free	Free

6. Depletion Allowance: 14% (Domestic) 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Measured by sold or used plus imports minus exports.
2/ Marketable phosphate rock; weighted value, all grades, domestic and exports.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.

Prepared by W. F. Stowasser, telephone number (202) 634-1190.

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8. Events, Trends, and Issues: The anticipated strong increase in U.S. demand for phosphate fertilizers did not develop because of unusually bad weather in the spring of 1984 and financial constraints on farmers' demand for fertilizer. From a 1983 base, demand for phosphate rock is expected to increase at an average annual rate of about 1.8% through 1990. It is estimated that in 1985 domestic mine production of phosphate rock will be 54 million tons and U.S. consumption will be 41 million tons. The United States has increased exports to a level of about 66% of its production either as rock or upgraded phosphate fertilizers.

Domestic supplies of phosphate rock were adequate to meet all demand elements. As domestic and international demand improved, closed mines in Florida were reopened. Although demand and production improved, profit margins did not improve for U.S. producers. It is estimated that phosphate rock costs of projected new mines in Florida and North Carolina will probably exceed market prices and it is unlikely, therefore, that new mines will be developed in the United States until economics improve.

Industry problems include high capital charges for new mines, depletion of low-cost, high-quality deposits, the cost and time required to permit new mines, restrictions on waste clay settling acreage and phosphogypsum stacks, and increasing severance taxes. These problems are translated into higher product costs that reduce the competitive position of the U.S. industry in international markets.

Although mined out lands in Florida have been reclaimed to form land and lakes, recent trends indicate a preference to reclaim with clay slimes, sand tailings, and overburden to develop land suitable for agricultural purposes and capable of becoming a new tax base to replace at least in part the loss of phosphate mine tax revenue.

9. World Mine Production and Reserve Base:

	Production		Reserve Base*
	1983	1984 e/	
United States	42,573	49,000	5,400,000
Israel	2,969	3,000	90,000
Jordan	4,749	5,000	510,000
Morocco	20,106	21,000	21,000,000
Senegal	1,249	2,000	130,000
South Africa, Republic of	2,742	2,600	2,600,000
Togo	2,081	2,000	50,000
Tunisia	5,924	5,600	120,000
Other Market Economy Countries	11,994	12,000	2,970,000
China	12,500	13,000	210,000
U.S.S.R.	27,200	27,500	1,300,000
Other Centrally Planned Economies	720	750	325,000
World Total (rounded)	135,000	143,000	35,000,000

10. World Resources: Most of the U.S. and world phosphate rock resources are widely distributed marine phosphorite deposits. Identified and undiscovered resources are estimated to contain billions of tons of contained phosphorus. Identified resources in North and West Africa and in the Middle East are estimated to be several times greater than present reserves. Large phosphate resources have been identified on the continental shelves and on sea mounts in the Atlantic and Pacific Oceans. Work is continuing to identify additional resources in these areas. Phosphate rock contains fluorine as an integral part of the mineral apatite. Uranium and vanadium are present in marine phosphorite deposits and rare earths are present in igneous apatite deposits in quantities that may be profitably recoverable.

11. Substitutes: There are no substitutes for phosphorus in agriculture.

* The criteria for the reserve base were established by a joint Bureau of Mines and U.S. Geological Survey working group. The criteria for classification of phosphate resources are given in Geological Survey Circular 882, Sedimentary Phosphate Resource Classification System of the U.S. Bureau of Mines and the U.S. Geological Survey.

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PLATINUM-GROUP METALS

(Platinum, palladium, iridium, osmium, rhodium, ruthenium)

(Data in thousand troy ounces, unless noted)

1. Domestic Production and Use: Domestic primary production was derived entirely as a byproduct of copper refining by three firms and was valued at about $1 million. Secondary metal was refined by about 20 firms, mostly on the east and west coasts. Platinum-group metals (PGM) were sold by at least 90 processors and retailers, largely in the Northeast, and were distributed among using industries as follows: Automotive, 35%; electrical and electronic, 25%; dental and medical, 20%; chemical, 10%; and other, 10%. The automotive, chemical, and petroleum refining industries used PGM mainly as catalysts. The other industries used PGM in a variety of ways that took advantage of their chemical inertness and refractory properties.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	3	7	8	6	6
Primary refined	3	7	9	9	9
Secondary:					
Nontoll-refined	331	392	344	287	370
Toll-refined	1,079	1,191	868	995	1,000
Imports for consumption:					
Refined 1/	3,109	2,611	2,150	2,790	4,300
Total	3,502	2,850	2,494	3,218	4,800
Exports:					
Refined 1/	592	651	439	446	500
Total	765	863	836	1,229	1,000
Consumption: Reported, sales to industry	2,206	1,921	1,873	1,914	2,100
Apparent 2/	2,640	2,414	1,871	2,797	4,100
Price, average, dollars per ounce:					
Producer:					
Platinum	439	475	475	475	475
Palladium	214	130	110	130	147
Dealer:					
Platinum	677	446	327	424	390
Palladium	201	95	67	136	160
Stocks, yearend:					
Government 3/	1,725	1,725	1,729	1,733	1,741
Industry	973	918	1,107	943	1,000
Employment: Refinery e/	400	400	400	400	400
Net import reliance 4/ as a percent of apparent consumption	87	83	81	90	91

3. Recycling: About 370,000 ounces of PGM were refined from scrap on a nontoll basis. The quantity of toll-refined secondary was much larger, amounting to about 1 million ounces. The proportion of new scrap to old scrap was not known.

4. Import Sources (1980-83): Republic of South Africa 49%, United Kingdom 15%, U.S.S.R. 13%, Other 23%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore	601.39	Free	Free	Free
Metals	605.02, 605.07	Free	Free	Free
Alloys	605.03, 605.08	11.2% ad val.	8.2% ad val.	65.0% ad val.
Scrap	605.70	Free	Free	Free

e/ Estimated.
1/ Includes both unwrought and semimanufactured.
2/ Domestic mine production plus nontoll scrap production and net import reliance.
3/ Includes platinum, palladium, and iridium; 2,400 ounces of iridium were purchased in 1983 but not added to inventory until 1984.
4/ Defined as refined imports - refined exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.

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6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: The General Services Administration (GSA) purchased, for the National Defense Stockpile, 600 ounces of grade B (99.8% minimum) iridium in October, and purchased an additional 1,200 ounces in November. GSA also purchased 3,600 ounces of grade B (99.8% minimum) palladium sponge in November.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months	Purchases, 11 Months
Platinum	1,310	440	-	-	-
Palladium	3,000	1,256	-	-	4
Iridium	98	30	-	-	2

In addition to quantities shown above, the stockpile contains 13,000 ounces of nonstockpile-grade platinum and 2,000 ounces of palladium.

8. Events, Trends, and Issues: In 1984, world production of PGM increased slightly from the level of the previous year. Sales of PGM to U.S. industries increased to 2.1 million ounces, with increases in the automotive, electrical and electronic, and petroleum refining industries, and a decrease in sales to the dental and medical industries. It is estimated that in 1985 domestic mine production of PGM will be less than 10,000 ounces and U.S. apparent consumption will be 4.1 million ounces. From a 1983 base, demand for PGM is expected to increase at an average annual rate of about 2.5% through 1990.

In July, the Commodity Futures Trading Commission approved trading of 25-troy-ounce platinum futures contracts. Trading began for the new contracts in August on the MidAmerica Commodity Exchange in Chicago. Contract specifications called for plate or ingot containing at least 99.9% pure platinum. It is expected that smaller firms, including merchants and scrap dealers, will use the MidAmerica Exchange, and that industrial users will continue to dominate trading on the New York Mercantile Exchange.

The Stillwater Complex in Montana contains major deposits of palladium, platinum, chromium, and nickel. A decision is expected in 1985 on whether to mine the deposit.

There were no significant environmental problems involved with refining PGM.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/
	1983	1984 e/	
United States	6	6	16,000
Canada	167	200	9,000
South Africa, Republic of	2,600	2,800	970,000
Other Market Economy Countries	106	100	-
U.S.S.R.	3,600	3,600	200,000
World Total (rounded)	6,500	6,700	1,200,000

10. World Resources: World resources of PGM are estimated to be 3.3 billion ounces. U.S. resources are estimated at 300 million ounces.

11. Substitutes: Potential substitutes are gold, silver, and tungsten in electrical and electronic uses; gold and ceramics in dental uses; metals, such as rare-earths, nickel, vanadium, and titanium, and molecular sieves, in catalytic uses. New or improved engines and fuels, and electric automobiles, could reduce the use of PGM in emission control catalysts in automobiles.

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POTASH

(Data in thousand metric tons K_2O equivalent)

1. Domestic Production and Use: The value of U.S. production of marketable potash, f.o.b. mine, in 1984 was about $250 million. Potash production was centered in southeastern New Mexico, where five companies, operating five mines by conventional mining of bedded deposits, produced 90% of the U.S. total. All New Mexico mines operated above 90% capacity. One company in Utah recovered potash by solution mining underground and pumping it to the surface for solar evaporation and flotation. One company in California recovered potash and coproduct boron compounds and salt cake from subsurface brines. About 95% of the U.S. potash output was used directly in the fertilizer industry and about 5% was used in the chemical industry. Most potash was produced as potassium chloride (muriate of potash). Potassium sulfate and potassium magnesium sulfate, produced for special crops, comprised about one-sixth of the potash production. Potash was distributed by train, truck, and barge to warehouses, wholesalers, and retailers. Retailers sold both potash and potash blended with other fertilizers in dry or liquid forms for distribution over the fields in both spring and fall.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Marketable	2,239	2,156	1,784	1,429	1,600
Imports for consumption	4,972	4,796	3,858	4,440	4,900
Exports	840	491	519	300	450
Consumption, apparent	6,349	6,213	5,123	5,653	6,100
Price, dollars per metric ton of K_2O, average, muriate f.o.b. mine 1/	133	137	109	100	110
Stocks, producer, yearend	273	520	520	437	390
Employment: Mine	1,800	1,830	1,620	1,100	1,050
Mill	1,450	1,400	1,140	930	800
Net import reliance 2/ as a percent of apparent consumption	65	65	65	75	74

3. Recycling: None.

4. Import Sources (1980-83): Canada 91%, Israel 6%, Other 3%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Potassium chloride	480.50	Free	Free	Free
Potassium sulfate	480.55	Free	Free	Free
Potassic fertilizers and fertilizer materials	480.75	Free	Free	Free

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Average prices based on actual sales, excluding soluble and chemical muriates.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.
4/ Total reserve base in Dead Sea equally divided between Israel and Jordan.

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8. Events, Trends, and Issues: Demand for potash in the United States increased about 8% in 1984 compared with that of 1983. Production in 1984 increased about 12% compared with that of 1983. The cessation of the payment-in-kind (PIK) program in 1984 and the increase in farm income due to the 1983 PIK program increased the farmer's demand for potash. Interest rates for the farmer have remained high. The price of muriate of potash rose 10% from the 1983 level which appeared to be below the long-term cost of production for most U.S. producers. The New Mexico mine that closed in 1983 and two operating mines were for sale in 1984. A Utah producer from brines remained closed in 1984 because of adverse weather conditions and a second Utah producer, which controlled nearly one-half of U.S. sulfate of potash capacity, closed down after its evaporation ponds were flooded.

Imports increased about 10% and exports increased about 50% compared with those of 1983. Exports rose primarily to Brazil after the U.S. Export-Import Bank initiated a "facility" to alleviate the problem of major bank reluctance to lend to Brazil for financing trade. This was particularly important because the U.S. dollar continued to be very strong in the world currency market. China and India appeared to prefer Canadian product and prices and Japan divided its potash import business between the two North American countries.

Two U.S. muriate of potash producers filed antidumping petitions with the U.S. Government against Israel, the German Democratic Republic, Spain, and the U.S.S.R.

It is estimated that in 1985 domestic mine production of potash will be about 1.6 million tons--approximately the present U.S. capacity--and U.S. apparent consumption will be about 6.2 million tons. From a 1983 base, demand for potash is expected to increase at an average annual rate of about 1.8% through 1990.

9. World Mine Production and Reserves Base:

	Production		Reserve Base 3/
	1983	1984 e/	
United States	1,429	1,600	360,000
Canada (sales)	6,203	6,700	9,700,000
France	1,537	1,600	50,000
Germany, Federal Republic of	2,419	2,450	600,000
Israel	1,000	1,200	4/ 600,000
Italy	125	130	40,000
Jordan	170	450	4/ 600,000
Spain	657	500	50,000
United Kingdom	302	320	30,000
Other Market Economy Countries	22	20	450,000
Developing Countries	--	--	120,000
German Democratic Republic	3,430	3,450	1,000,000
U.S.S.R.	9,300	9,500	3,800,000
Other Centrally Planned Economies	25	25	20,000
World Total (rounded)	26,600	27,900	17,000,000

10. World Resources: Estimated domestic potash resources total about 6 billion tons. Most of this lies between 6,000 and 10,000 feet deep, in a 1,200-square-mile area of Montana/North Dakota as an extension of the Williston Basin deposits in Saskatchewan. The Paradox Basin in Utah contains approximately 2 billion tons, mostly at depths of more than 4,000 feet. An unknown quantity of potash resources lie about 7,000 feet under central Michigan. Estimated world resources total about 250 billion tons. The potash deposits in the U.S.S.R. account for most of the Centrally Planned Economy countries' resources. Very large resources, about 10 billion tons and mostly carnallite, occur in Thailand.

11. Substitutes: There are no substitutes for potash as an essential plant nutrient.

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PUMICE AND PUMICITE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The estimated value of pumice and pumicite sold or used in 1984 was $5.2 million. Domestic output came from 21 producers in 8 States. The principal producing States were California, Idaho, New Mexico, and Oregon; their combined production accounted for about 97% of the national total. California led all producing States with six active operations. The major uses of pumice and pumicite were in concrete aggregate and building block, about 92% of apparent consumption.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine 1/	543	499	416	449	520
Imports for consumption	194	92	121	184	211
Exports e/	1	1	1	1	1
Consumption, apparent	736	590	536	632	730
Price: Average value, dollars per ton, f.o.b. mine or mill	7.86	8.64	9.01	9.99	10.00
Stocks, yearend		Not available			
Employment: Mine and mill	60	60	60	60	60
Net import reliance 2/ as a percent of apparent consumption	26	15	22	29	29

3. Recycling: None.

4. Import Sources (1980-83): Greece 96%, Other 4%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Used in the manufacture of masonry products such as building blocks, bricks, tiles, and similar forms	519.05	Free	Free	Free
Crude or crushed:				
Valued not over $15 per ton	519.11	0.01¢/lb	0.01¢/lb	0.1¢/lb
Valued over $15 per ton	519.14	0.035¢/lb	0.035¢/lb	0.25¢/lb
In grains or ground, pulverized or refined	519.31	0.14¢/lb	0.13¢/lb	0.75¢/lb
Millstones, abrasive wheels, and abrasive articles, n.s.p.f.	519.93	5.3% ad val.	4.7% ad val.	35% ad val.
Articles, n.s.p.f.	523.61	3.9% ad val.	2.8% ad val.	35% ad val.

6. Depletion Allowance: 5% (Domestic), 5% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. N.s.p.f. Not specifically provided for.
1/ Quantity sold or used by producers.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.
4/ Excluding Centrally Planned Economies.

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8. Events, Trends, and Issues: From a 1983 base, demand for pumice and pumicite is expected to increase at an average annual rate of about 2% through 1990. Domestic reserves of pumice are expected to adequately supply domestic demand. Changing geographic demand patterns coupled with increasing transportation costs and lack of detailed reserve information could create problems for selecting new production locations. It is estimated that in 1985 domestic mine production of pumice and pumicite will be 550,000 tons and U.S. apparent consumption will be 750,000 tons.

   All domestic mining of pumice in 1984 was by open pit methods and generally occurred in relatively remote areas where land use conflicts were not severe. Although the generation and disposal of reject fines in mining and milling resulted in a dust problem at some operations, the environmental impact was restricted to a small geographical area.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 3/
	1983	1984 e/	
United States	449	520	Large
France	440	450	NA
Germany, Federal Republic of	165	170	NA
Greece	2,340	2,400	NA
Italy	6,270	6,300	NA
Other Market Economy Countries	2,100	2,100	NA
Centrally Planned Economies	NA	NA	NA
World Total 4/ (rounded)	11,800	11,900	NA

10. World Resources: The domestic identified resources of pumice and pumicite in the West are estimated to be at least 25 million tons. The estimated resources in the Western and Great Plains States are 250 million to 450 million tons.

11. Substitutes: Transportation cost determines the maximum distance that pumice and pumicite can be shipped and remain competitive with alternate materials. Alternate competitive materials that can be substituted for pumice and pumicite for several end uses include expanded shale and clay, diatomite, and crushed aggregates.

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QUARTZ CRYSTAL, INDUSTRIAL

(Data in thousand pounds, unless noted)

1. Domestic Production and Use: There was no reported U.S. production of natural quartz suitable for direct electronic or optical applications. However, lascas 1/ was mined by two companies in Arkansas. In addition, seven operations used lascas to manufacture cultured quartz crystal. Estimated lascas production in 1984 increased sharply and had a value of about $1.6 million. This large production increase was due to the startup of a second company as well strong economic recovery in the electronics industry. Quartz crystal was essential for making piezoelectric filter devices that separate desired from undesired portions of the frequency spectrum and oscillators that provided single frequency signal sources. Filters and oscillators were used for a wide variety of communications and instrumentation purposes.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine 2/e/	400	175	200	600	2,500
Plant: Cultured (as-grown)	757	660	478	426	1,000
Imports for consumption:					
Lascas	816	389	417	153	500
Natural electronic 3/	4/	4/	4/	4/	4/
Cultured	Not available				
Exports:					
Lascas	NA	NA	NA	339	1,400
Natural electronic 3/	91	127	69	28	30
Cultured (mostly lumbered) 3/	219	125	115	80	300
Shipments from Govt. stockpile excesses:					
Natural electronic	-	311	16	4	90
Consumption, reported:					
Lascas 5/	1,026	852	533	677	1,600
Natural electronic	17	14	16	13	15
Cultured 6/	765	609	482	424	700
Consumption, apparent:					
Lascas 7/	NA	NA	NA	673	1,596
Natural electronic	Not available				
Cultured	Not available				
Price, average value, dollars per pound:					
Lascas	0.50 to 3.60				
Cultured	20 to 550				
Stocks, industry, yearend:					
Lascas (for cultured crystal only)	1,000	1,026	1,005	746	750
Natural electronic (fabricator)	62	61	48	37	40
Cultured (fabricator)	82	64	74	53	53
Employment, mine, processing plant e/	10	11	18	21	75
Net import reliance 8/ as a percent of apparent consumption:					
Lascas	NA	NA	NA	11	E
Natural electronic 9/	Not available				
Cultured	Not available				

3. Recycling: None.

e/ Estimated. NA Not available. E Net Exporter.
1/ Lascas is natural nonelectronic-grade quartz used as feedstock for growing cultured quartz crystal and for production of fused quartz.
2/ Lascas only; specimen and jewelry material excluded.
3/ Quantities calculated from pricing information.
4/ Less than 1/2 unit.
5/ Excluding quartz crystal used by the fused quartz industry.
6/ Reported consumption of cultured includes cultured quartz crystal consumed by growers as well as by manufacturers of intermediate products and finished crystal units.
7/ Defined as imports - exports + adjustments for Government and industry stock changes.
8/ Due to Government stockpile release of excess material.
9/ See page 180 for definitions.

Prepared by John E. Ferrell, telephone number (202) 634-1177.

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4. Import Sources (1980-83): Brazil 100%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Brazilian Pebble, Crude	521.21	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: The General Services Administration was offering excess stockpile-grade quartz crystal for sale. In addition to the quantities shown below, the stockpile contained 957 pounds of nonstockpile-grade quartz crystal.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Quartz crystal	600	1,968	84	105

8. Events, Trends and Issues: The United States and Japan are the world leaders in production of cultured quartz crystal. The United States continued to depend on small quantities of Brazilian natural quartz needed as seed material for growing cultured quartz and for a few direct applications such as oil well pressure transducers.

In 1984, records were set for lascas and cultured quartz production. One reason for the lascas record was attributed to the addition of the second mine in Arkansas. An increased level of lascas exports for the fused and cultured quartz industries also contributed. Improved demand for consumer products using quartz crystal devices, such as automobiles, video cassette recorders, cordless telephones, and personal computers, helped set these records.

Indications that Japan was expanding its cultured quartz crystal capacity have caused some uncertainty for the future of the U.S. quartz crystal industry. U.S. cultured quartz crystal production in 1985 may not reach the 1984 level. It is estimated that in 1985 domestic production of lascas will be 3 million pounds and U.S. apparent consumption will be 1.4 million pounds. The lascas forecasts reflect both a possible expansion by the new mine and an increase in lascas markets worldwide. From a 1983 base, demand for lascas by the cultured quartz industry is expected to increase at an average annual rate of about 21.3% through 1990.

9. World Mine Production and Reserve Base:

	Production 1983	Production 1984 e/	Reserve Base 9/
United States 2/	600	2,500	Small
Brazil	NA	NA	Large
Other Market Economy Countries	NA	NA	NA
Centrally Planned Economies	NA	NA	NA
World Total	NA	NA	NA

10. World Resources: Limited resources of natural quartz crystal, suitable for direct electronic or optical use, are available throughout the world. World dependence on these resources will continue to decline because of increasing acceptance of cultured quartz crystal as an alternate material; however, this will mean an increased dependence on lascas for growing cultured quartz.

11. Substitutes: Quartz crystal is the best material for frequency-control oscillators. Other materials, such as dipotassium tartrate, are usable only in specific applications as oscillators and frequency filters.

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RARE-EARTH METALS 1/

(Data in metric tons of rare-earth oxide (REO) content, unless noted)

1. Domestic Production and Use: In 1984, rare-earth ore minerals were mined by two companies in the United States. Bastnasite, mined in California by surface methods, accounted for most of domestic rare-earth production. Monazite was mined in Florida by placer methods and was a byproduct of processing minerals sands for titanium and zirconium minerals. Thorium and yttrium were byproducts of the separation of rare earths from monazite. The United States was the world's principal producer and consumer of rare earths and was a major exporter of rare-earth products. Rare-earth ores and compounds were processed mainly by four companies with plants located in Arizona, Texas, Tennessee, California, Colorado, and Pennsylvania. Industrial consumption was estimated as follows: Petroleum catalysts, 65%; metallurgical uses (including pyrophoric alloys), 20%; ceramic and glass, 12%; and other uses (electrical, phosphors, permanent magnets, nuclear, research, and miscellaneous), 3%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production of rare-earth concentrates 2/	15,986	17,082	17,501	17,083	17,300
Imports for consumption e/:					
Monazite	2,831	4,108	3,962	2,215	3,300
Metals, alloys, oxides, and compounds	1,624	1,631	1,695	1,857	3,300
Exports e/: Ore and concentrate	4,741	5,056	2,565	2,684	4,300
Ferrocerium and pyrophoric alloys	14	9	22	59	30
Shipments from Govt. stockpile excesses	1,257	802	364	-	-
Consumption, apparent e/	18,100	20,000	17,100	19,600	21,000
Prices, dollars, yearend 1984: Monazite concentrates, 342-375 per metric ton; bastnasite concentrates, 2.14 per kilogram REO. Prices for processed rare earths, per kilogram: Mixed compounds, 1.85 (chloride) to 18.52 (oxalate); high-purity oxides, 19 (lanthanum) to 5,200 (lutetium); metal, 125 (cerium) to 14,200 (lutetium); mischmetal, 12.35.					
Stocks, producer and processor, yearend	W	W	W	W	W
Employment, mine and mill e/ 3/	250	275	303	266	270
Net import reliance 4/ as a percent of apparent consumption	11	14	E	12	16

3. Recycling: Insignificant.

4. Import Sources (1980-83): Monazite--Australia 95%, Malaysia 5%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrates 5/	601.12 & 601.45	Free	Free	Free
Cerium oxide, compounds	418.42 & 418.44	9.2% ad val.	7.2% ad val.	35.0% ad val.
Alloys, mischmetal	632.78	36¢/lb	32¢/lb	$2/lb
Ferrocerium and other pyrophoric alloys	755.35	29¢/lb + 3.5% ad val.	22¢/lb + 2.6% ad val.	$2/lb + 25.0% ad val.

6. Depletion Allowance: Monazite, 22% on thorium content and 14% on rare-earth content (Domestic), 14% (Foreign). Bastnasite and xenotime, 14% (Domestic and Foreign).

e/ Estimated. E Net exports. W Withheld to avoid disclosing company proprietary data.
1/ See also Yttrium and Thorium.
2/ Comprises only the rare earths derived from bastnasite.
3/ Total employment at a rare-earth mine in California and at heavy minerals sands operations in Florida and Georgia. The latter mines produced monazite concentrate as a byproduct of mining rutile, ilmenite, and zircon, and employees were not assigned to specific commodities.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ "Concentrates" includes only those made by crushing, flotation, washing, or by other physical or mechanical processes that do not involve substantial chemical change. The category thus excludes "yttrium concentrates" and other mixed "rare-earth concentrates" that have undergone substantial chemical change through processing.
6/ Increased from 443 tons at yearend 1983 as a result of inventory adjustment.
7/ See page 180 for definitions.

Prepared by J. B. Hedrick, telephone number (202) 634-1082.

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7. Government Stockpile:

Material	Goal	Stockpile Status--11-30-84 Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
REO in sodium sulfate 6/	-	457	0	-

8. Events, Trends and Issues: World and domestic demand for the rare earths in 1984 increased above that of 1983. Demand for rare earths used in permanent magnets was strong and created a shortage of samarium oxide. The market for recently developed neodymium-containing permanent magnets grew in 1984, primarily in research for automotive starter motors and various other applications. Consumption of rare-earth compounds used in television, x-ray intensifying, and lighting phosphors increased. Demand for the lanthanides in mischmetal and ferroalloys was weak and has not recovered from the depressed levels of 1982. Demand for rare earths in most other end uses in 1984 was expected to remain essentially the same as in 1983. From a 1983 base, demand for rare earths is expected to increase at an average annual rate of about 3% through 1990. It is estimated that in 1985 domestic mine production of rare earths will be 18,000 tons 2/ and U.S. apparent consumption will be 22,000 tons.

The lanthanides were in abundant domestic and world supply, and no critical shortages were anticipated. Industrial demand varies widely among the lanthanides. Rare-earth ores have been mined for years to obtain a few of the more useful elements. This has led to a surplus of the less useful elements and some of the associated elements, such as thorium. The demand pattern continued to shift toward individual compounds and metals and special mixtures, such as those used in phosphors, permanent magnets, lasers, fuel cells, and electronics. Capacity to process these individual rare earths was limited, and supply problems may be encountered if a large demand for any of the individual rare earths develops, except possibly cerium. Improved knowledge of lanthanide properties may lead to new commercial applications.

9. World Mine Production and Reserve Base:

	Mine Production e/ 1983	Mine Production e/ 1984	Reserve Base 7/
United States	2/17,083	2/17,300	5,200,000
Australia	7,975	8,000	200,000
Brazil	1,100	1,100	73,000
Canada	-	-	197,000
India	2,200	2,200	2,500,000
Malaysia	187	200	35,000
Thailand	77	80	1,100
Other Market Economy Countries	165	170	950,000
China	6,000	6,000	38,000,000
Other Centrally Planned Economies	1,500	1,500	500,000
World Total (rounded)	36,000	37,000	48,000,000

10. World Resources: Some elements of the rare-earth group of metals are relatively abundant in the earth's crust, but minable concentrations are uncommon. Bastnasite (a fluocarbonate) is mined extensively in the United States and China. Monazite (a phosphate) is recovered largely as a byproduct of processing heavy minerals sands in various parts of the world, primarily Australia and India. The rare earths also occur in many other minerals and are recoverable as byproducts from phosphate rock and from spent uranium leach solutions. Total world undiscovered resources of rare earths are believed to be very large relative to expected demand.

11. Substitutes: Substitutes are available for many applications of rare-earth elements, but generally are less effective. In major use categories there are no satisfactory substitutes.

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RHENIUM

(Data in pounds of rhenium content, unless noted)

1. Domestic Production and Use: During 1984, rhenium was produced by two companies. Rhenium was recovered from porphyry copper deposits in the southwestern United States. Rhenium was a product of roasting molybdenum concentrates. Rhenium-containing products included ammonium perrhenate, perrhenic acid, and metal powder. Platinum-rhenium reforming catalysts continued to be the major end use product and accounted for about 90% of rhenium consumption. These catalysts were used to increase the octane rating in the production of lead-free petroleum products. About 10% of the rhenium was used in the production of thermocouples, heating elements, x-ray tubes and targets, flashbulbs, vacuum tubes, electrical contacts, metallic coatings, and for research and development. The estimated value of rhenium consumed in 1984 was $2.7 million.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	W	W	W	W	W
Imports for consumption	5,504	9,669	5,369	6,570	9,500
Exports	Negligible				
Consumption: Reported e/	7,300	6,600	5,900	8,800	9,000
Apparent	W	W	W	W	W
Price, average value, dollars per pound:					
Metal powder, 99.99% pure	1,500	590	410	300	300
Perrhenic acid	1,400	510	375	250	200
Stocks yearend, consumer, producer, dealer	W	W	W	W	W
Employment	Small				
Net import reliance 1/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Small amounts of molybdenum-rhenium and tungsten-rhenium scrap have been processed during the past few years by several companies.

4. Import Sources (1980-83): Chile 61%, Federal Republic of Germany 38%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Unwrought metal, waste, and scrap 2/	628.90	4.2% ad val.	3.7% ad val.	25% ad val.
Wrought metal	628.95	6.8% ad val.	5.5% ad val.	45% ad val.
Ammonium perrhenate	417.4420	3.4% ad val.	3.1% ad val.	25% ad val.
Perrhenic acid	416.4540	4.9% ad val.	4.2% ad val.	25% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ Duty on waste and scrap suspended indefinitely.
3/ See page 180 for definitions.
4/ Excluding U.S. production.

Prepared by J. W. Blossom, telephone (202) 634-1021.

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8. Events, Trends, and Issues: During 1984, the rhenium price decreased. The average price was $300 per pound for rhenium metal and $200 per pound for ammonium perrhenate. Imports of rhenium increased an estimated 45% from those of 1983. Chile and the Federal Republic of Germany continued to supply the majority of the rhenium imported. The United States relies on imports for most of its supply of rhenium.

From a 1983 base, domestic demand for rhenium is expected to increase at an average annual rate of about 3.5% through 1990. It is estimated that in 1985 U.S. apparent consumption of rhenium will be 9,400 pounds.

Due to the scarcity and minor output of rhenium, its production and processing pose no known threat to the environment. In areas where it is recovered, pollution control equipment for sulfur dioxide also prevents most of the rhenium from escaping into the atmosphere.

The main problems related to rhenium are: The low recovery of rhenium from porphyry copper ores; uncertain economic return on recovery equipment due to uncertain future prices and long-term demand; increased use of petroleum reforming catalysts containing no rhenium; and environmental costs imposed on the copper and molybdenum industries which recover rhenium as a byproduct.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	W	W	10,000,000
Canada	9,000	9,000	3,400,000
Chile	7,000	5,300	5,600,000
Peru	800	600	1,200,000
U.S.S.R.	4,000	4,000	1,700,000
Other	400	400	800,000
World Total	4/21,200	4/19,300	22,700,000

10. World Resources: Most rhenium occurs with molybdenum in porphyry copper deposits. Identified U.S. resources are estimated to be about 10 million pounds, and the identified resources of the rest of the world are approximately 13 million pounds. In the U.S.S.R., rhenium also exists in sedimentary copper deposits.

11. Substitutes: Substitutes for rhenium in platinum-rhenium catalysts are being evaluated continually. Iridium has achieved commercial success in one such application. Other metals being evaluated for catalytic use include gallium, germanium, indium, selenium, silicon, tin, tungsten, and vanadium. The use of these and other metals in bimetallic catalysts may erode rhenium's share of the catalyst market. Materials that can substitute for rhenium in various end uses are: Cobalt and tungsten for coatings on copper x-ray targets; rhodium and rhodium-iridium for high temperature thermocouples; tungsten and platinum-ruthenium for coatings on electrical contacts; and tungsten and tantalum for electron emitters.

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RUBIDIUM

(Data in pounds of rubidium content, unless noted)

1. Domestic Production and Use: One domestic company manufactured rubidium products from lepidolite ore imported from Canada. Small quantities of rubidium, usually in the form of chemical compounds, were used mainly in research and development. Rubidium also was used in electronic and medical applications.

2. Salient Statistics--United States:	1980	1981	1982	1983	1984 e/
Production: Mine			None		
Metal and compounds	W	W	W	W	W
Imports for consumption:					
Ores and raw materials	-	-	e/4,700	-	-
Rubidium metal and compounds			Not available		
Exports			Not available		
Consumption, apparent:					
Metals and compounds			Not available		
Price: Dollars per pound					
Metal, 99.5%+, 1-4 pound lots	300	300	300	300	300
Rubidium compounds, range	65-110	65-110	78-132	84-132	90-132
Rubidium oxide	NA	NA	500	500	500
Stocks, producer, yearend	W	W	W	W	W
Employment: Plant e/	25	25	25	25	25
Net import reliance 1/ as a percent of apparent consumption			Not available		

3. Recycling: None.

4. Import Sources (1980-83): Canada, 100%.

5. Tariff: Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Rubidium	415.40	4.0% ad val.	3.7% ad val.	25.0% ad val.
Rubidium compounds	423.00	4.0% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.

Prepared by W. Timothy Adams, telephone number (202) 634-1082.

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8. Events, Trends, and Issues: In 1984, rubidium and its compounds were largely the subject of laboratory study and were of little commercial significance. No major breakthroughs or developments were anticipated that would change the production or consumption pattern in 1985. From a 1978 base, demand for rubidium is expected to increase at an average annual rate of about 0.3% through 1990. Domestic rubidium production is entirely dependent on imported lepidolite ores. Because of the small scale of production of rubidium products, no significant environmental problems have been encountered.

9. World Mine Production and Reserve Base: The Canadian mining operation for lepidolite ore remained closed during 1984. The reserve base 2/ for rubidium in North America was estimated at 5 million pounds.

10. World Resources: Rubidium forms no known minerals in which it is the predominant metallic constituent, but occurs chiefly as a replacement for potassium, especially in minerals formed late in the crystallization of pegmatites. Meaningful estimates of rubidium resources cannot be made, but pollucite deposits contain about 1% rubidium. See the cesium chapter on pages 30 and 31 for additional information.

11. Substitutes: The properties of rubidium and its compounds are so similar to those of cesium and its compounds that compounds of rubidium and cesium are used interchangeably in many applications. Cesium, germanium, tellurium, selenium, silicon, and several other elements and compounds can substitute for rubidium as photosensitive materials.

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kUTILE 1/

(Data in thousand short tons of concentrate, unless noted)

1. Domestic Production and Use: Rutile was produced at one mine in Florida in 1984. At two other mines in Florida, rutile was included in a bulk concentrate containing mostly ilmenite and leucoxene. The major coproduct of these titanium minerals is zircon. The value of reported U.S. rutile consumption in 1984, assuming an average price of $310 per ton, was about $85 million. Of 25 consuming firms, located mainly in the Eastern United States, 5 companies used 84% of the rutile consumed to make titanium dioxide pigment. Welding rod coatings consumed 1%; miscellaneous applications, which include titanium metal and glass fibers, 15%. Five firms in Nevada, Ohio, Oregon, and Washington used titanium tetrachloride made from rutile to manufacture titanium metal.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	W	W	W	W	W
Imports for consumption 2/	282	202	163	112	165
Exports e/	18	7	2	4	5
Shipments from Govt. stockpile excesses			None		
Consumption: Reported 2/	298	285	239	266	275
Apparent	W	W	W	W	W
Prices, dollars per ton, yearend:					
f.o.b. Atlantic and Great Lakes ports, spot	440	460	460	415	475
Bulk, large lots, f.o.b. Titen, FL.	-	350	310	310	310
Synthetic, f.o.b. Mobile, AL.	310	340	350	350	350
Stocks: Mine, distributor, and consumer, yearend	e/157	163	176	130	122
Employment: Mine and mill 3/	410	371	361	336	375
Net import reliance 4/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: None.

4. Import Sources (1980-83): Australia 68%, Sierra Leone 16%, Republic of South Africa 12%, Other 4%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Rutile ore	601.5140	Free	Free	Free
Synthetic rutile 5/	603.7010	5.9% ad val.	5.0% ad val.	30.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Stockpile grade	106	39	-	-

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Ilmenite and Titanium.
2/ Includes synthetic rutile.
3/ Employment at three sand deposit operations in Florida, which produced either rutile concentrate or a titanium mineral concentrate, where ilmenite and zircon were major coproducts, and where employees were not assigned to specific commodities.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.
6/ Excluding U.S. production.

Prepared by L. E. Lynd, telephone number (202) 634-1073.

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8. Events, Trends, and Issues: Production of rutile increased in 1984. Production of synthetic rutile at the only U.S. synthetic rutile plant at Mobile, AL, also increased. Production of natural rutile in Australia, which in 1983 was the source of about 53% of the world's supply, was about 10% higher than in 1983. U.S. imports from Australia of natural and synthetic rutile totaled 80,000 tons, 12% less than in 1983. Synthetic rutile imports in 1984 were about 30,000 tons compared with 21,000 tons in 1983, and came entirely from Australia. It is estimated that in 1985 reported consumption of rutile will rise to 290,000 tons, reflecting increased demand for titanium dioxide. From a 1981 base, demand for natural and synthetic rutile is expected to increase at an average annual rate of about 2% through 1990.

A major impediment to more extensive use of natural rutile is the limited supply. On the east coast of Australia, the reserve base of rutile is about 8 million tons but because of environmental concerns, only about 5 million tons can be mined. Deposits on Australia's west coast contain 3 million tons of minable rutile. Production in Sierra Leone increased to record levels in 1983 and 1984, and output in the Republic of South Africa was close to full capacity.

Mining of rutile is entirely from sand deposits which contain only a few percent of valuable minerals. While the discarded sand can be readily returned to the mined area, regraded and seeded to aid restoration of the environment, there has been continuing pressure to curtail sand mining in some areas.

Fewer environmental pollution problems are encountered when pigment is made from rutile rather than ilmenite. The chloride process, using a rutile feed, generates about 0.2 ton of waste per ton of titanium dioxide product, while the alternate sulfate process, using ilmenite, generates about 3.5 tons of waste per ton of product. Producing synthetic rutile from ilmenite results in about 0.7 ton of waste, mainly iron oxide, per ton of product. Direct chlorination of ilmenite generates about 1.2 tons of waste, mainly ferric chloride, per ton of titanium dioxide.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/
	1983	1984 e/	
United States	W	W	1,700
Australia	190	210	11,600
Brazil e/	-	-	87,700
India e/	8	9	5,000
Italy	-	-	15,000
Sierra Leone e/	80	95	2,700
South Africa, Republic of e/	60	60	7,000
Sri Lanka	9	10	900
Centrally Planned Economies e/	11	11	3,000
World Total	6/358	6/395	134,600

10. World Resources: Identified world resources of rutile (including anatase) total about 200 million tons of contained TiO_2. Major rutile resources occur in Australia, India, Italy, Sierra Leone, the Republic of South Africa, and the United States. The Brazilian resources are mainly anatase, and were reportedly being developed.

11. Substitutes: Ilmenite, titaniferous slag, and synthetic rutile made from ilmenite may be used instead of natural rutile for making pigment, metal, or welding rod coatings.

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SALT

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The quantity of all forms of salt sold or used by producers in 1984 increased an estimated 9% compared with 1983, and the value increased from $597 million in 1983 to about $670 million in 1984. Forty-four companies operated 83 plants in 15 states with the 10 largest companies accounting for over 75% of the salt sold or used. Three states, Louisiana, Texas, and New York, furnished 70% of domestic output.

   The chemical industry consumed about 55% of the salt sold or used by producers. Most of the salt used by the chemicals sector was for manufacturing chlorine and caustic soda. Salt used for highway deicing accounted for approximately 20% of the domestic salt demand. Paper and food products, agriculture, water treatment, petroleum, metal production, and several other minor applications constituted the remaining end uses of salt.

   Based on final 1983 data, the estimated percentage of salt sold or used by type in 1984 was salt in brine, 52%; rock salt, 34%; vacuum and open-pan evaporated salt, 9%; and solar evaporated salt, 5%.

2. Salient Statistics--United States: 1/

	1980	1981	1982	1983	1984 e/
Production	41,483	38,899	37,651	32,973	38,750
Sold or used by producers	40,352	38,907	37,880	34,573	37,750
Imports for consumption	5,263	4,319	5,451	5,997	6,000
Exports	831	1,046	1,001	517	750
Consumption, apparent	44,784	42,180	42,330	40,053	43,000
Price, average value, dollars per ton, f.o.b. mine/plant					
Vacuum and openpan salt	76.44	79.68	86.63	89.39	90.00
Solar salt	15.65	18.35	18.01	21.47	22.00
Rock salt	14.65	13.76	13.90	13.43	14.00
Salt from brine	6.50	5.91	6.21	5.22	5.75
Pressed block, all sources	63.20	66.14	67.84	71.52	72.50
Stocks, producer, yearend e/	2,671	2,663	2,434	834	1,834
Employment, mine and plant	5,000	5,600	5,000	5,000	4,800
Net import reliance 2/ as a percent of apparent consumption	7	8	11	18	10

3. Recycling: None.

4. Import Sources (1980-83): Canada 38%, Mexico 28%, Bahamas 15%, Chile 5%, Other 14%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
In brine	420.92	4.2% ad val.	3.7% ad val.	20% ad val.
In bulk	420.94	1.1% ad val.	Free	26% ad val.
Other	420.96	Free	Free	11¢/100 lbs

6. Depletion Allowance: 10% (Domestic), 10% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Excludes Puerto Rico.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.

Prepared by D. E. Morse, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: Increased requirements for salt by the chemical industry raised demand an estimated 7% compared with 1983. Investments were made by two companies to increase productivity and capacity at rock salt mines in Louisiana. Two mines, one mine in Michigan and one in Louisiana, were shut down during the year. High water level as a result of spring runoff into Great Salt Lake adversly affected the solar operations of three companies in Utah. A bill to reduce the use of deicing salt was passed by the Wisconsin State Senate. The Salt Institute conducted over 100 "Sensible Salting Seminars" for U.S. and Canadian snow and ice control personnel.

From a 1980 base, demand for salt is expected to increase at an average annual rate of about 1.5% through 1990. It is estimated that in 1985 domestic mine production of salt will be 38 million tons and U.S. apparent consumption will be 44 million tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	Quantity
United States (sold or used)1/	34,573	37,750	Large
Australia	6,600	6,600	
Canada	9,500	9,500	Reserves are large in
France	7,910	7,500	principal salt-producing
Germany, Federal Republic of	11,500	11,500	countries but grades are
India	11,004	11,000	unknown. The oceans
Italy	5,200	5,000	comprise an inexhaustible
Mexico	6,100	8,500	supply of salt.
United Kingdom	8,500	8,500	
Other Market Economy Countries	29,263	30,200	
China	17,500	18,000	
Poland	4,700	5,000	
U.S.S.R.	17,900	18,000	
Other Centrally Planned Economies	12,500	12,800	
World Total	182,750	189,850	

10. World Resources: World resources of salt are virtually unlimited. Domestic resources of rock salt and salt from brine are located in the northeast, central western, and southern Gulf Coast States. Saline lakes and solar evaporated salt facilities are close to populated regions in the Western United States. Nearly every country in the world has salt deposits or solar evaporation operations of various sizes.

11. Substitutes: There were no economic substitutes or alternates for salt. Calcium chloride, hydrochloric acid, and potassium chloride can be substituted for salt in deicing, certain chemical processes, or food flavoring, but at higher cost.

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SAND AND GRAVEL
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Construction sand and gravel valued at $2.0 billion was produced by 3,600 companies from 5,000 operations in 50 States. Leading States in order of volume were California, Texas, Alaska, Ohio, Michigan, Arizona, Minnesota, Illinois, New York and Washington, which accounted for about 52% of the total output. About 38% of this tonnage was used as aggregate in concrete for residential and nonresidential buildings, highways, bridges, dams, waterworks and airports, and other concrete products; 22% in roadbases and coverings; 17% for construction fill; 14% as asphaltic concrete aggregates and other bituminous mixtures; and 9% was for railroad ballast, snow and ice control, and other.

   Industrial sand and gravel valued at $370 million was produced by 97 companies from 176 operations in 35 States. Leading States in order of volume were Illinois, Michigan, New Jersey, California, and Texas. Their combined production represented 54% of the national total. About 35% of this tonnage was used as glassmaking sand, 25% as foundry sand, 7% as abrasive sand, 4% as hydraulic fracturing sand, and 29% for other miscellaneous or unspecified uses.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Construction sand and gravel:					
Production	763,100	e/690,000	594,000	e/655,100	680,000
Imports for consumption	502	333	185	123	120
Exports	1,274	1,265	1,128	1,300	1,300
Consumption, apparent	762,300	e/689,000	593,100	e/653,900	680,000
Price: Average value, dollars per ton	2.62	e/2.79	2.82	e/2.90	2.95
Stocks, yearend		Not available			
Employment, quarry and mill e/	48,000	46,000	44,000	45,000	45,000
Net import reliance 1/ as a percent of apparent consumption		Net exporter			
Industrial sand and gravel:					
Production	29,600	29,980	27,400	26,617	29,000
Imports for consumption	39	4	90	58	65
Exports	1,177	1,132	818	1,047	700
Consumption, apparent	28,500	28,900	26,700	25,600	28,000
Price: Average value, dollars per ton	9.90	11.08	11.82	12.59	12.90
Stocks, yearend		Not available			
Employment, quarry and mill e/	1,600	1,600	1,500	1,500	1,500
Net import reliance 1/ as a percent of apparent consumption		Net exporter			

3. Recycling: Asphalt road surfaces and cement concrete surfaces were recycled on a limited but increasing basis.

4. Import Sources (1980-83): Construction sand and gravel: Canada 91%, Other 9%.
   Industrial sand and gravel: Australia 82%, Canada 7%, Other 11%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
95% or more silica and not more than 0.6% iron oxide	513.11	$0.06/lt	Free	$2.00/lt
Other	513.14	Free	Free	Free

6. Depletion Allowance: (Domestic and Foreign)
   Sand and Gravel: Common varieties 5%, industrial sand or pebbles 14%.

7. Government Stockpile: None.

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.

Prepared by L. L. Davis, telephone number (202) 634-1184 for construction sand and gravel.
Prepared by V. V. Tepordei, telephone number (202) 634-1185, for industrial sand.

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8. Events, Trends, and Issues: Construction sand and gravel output increased slightly in 1984. It is estimated that 1985 domestic production and U.S. apparent consumption will be about 700 million tons each. From a 1980 base, demand for construction sand and gravel is expected to increase at an average annual rate of 2% through 1990, giving a probable forecast demand in 1990 of about 900 million tons.

   Industrial sand and gravel output increased in 1984 by about 8%. It is estimated that 1985 domestic production and U.S. apparent consumption will be 30 million and 29 million tons, respectively. From a 1980 base, demand for industrial sand and gravel is expected to increase at an average annual rate of 1.5% through 1990, giving a probable forecast demand in 1990 of about 35 million tons.

   The sand and gravel industry continued to be concerned with safety regulations and environmental restrictions in 1984. Shortages in urban and industrialized areas were expected to continue to increase due to local zoning regulations and land development alternatives. This was expected to continue to cause a movement of sand and gravel operations from high population centers.

9. World Mine Production and Reserve Base:

	Mine Production e/		Reserve Base 2/
	1983	1984	
United States	682,000	709,000	The reserve base is controlled largely by land use and/or environmental constraints. Local shortages of sand or gravel are common.
Other countries	NA	NA	

10. World Resources: Sand and gravel resources of the world are large. However, due to their geographic distribution, environmental restrictions, and quality requirements for some uses, their extraction is sometimes uneconomic. The most important commercial sources of sand and gravel have been river flood plain, river channel, and glacial deposits. Marine deposits could become important in the future. Quartz-rich sand and sandstones, the main source of industrial silica sand, occur throughout the world.

11. Substitutes: Crushed stone remains the predominant alternative for construction aggregate use. Silica sand continues to be the major material used for glassmaking and for foundry and molding sands; alternates are zircon, olivine, staurolite, and chromite sands.

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SELENIUM

(Data in metric tons of selenium content, unless noted)

1. Domestic Production and Use: Selenium production during 1984 was valued at an estimated $6 million. Primary selenium was recovered as a byproduct from anode slimes generated in the electrolytic refining of copper. Four copper refineries, located one each in New Jersey and Utah, and two in Texas, accounted for the domestic production of selenium. Scrap xerographic materials were exported for processing to recover secondary selenium. The estimated consumption of selenium by end use was electronic and photocopier components, 35%; glass manufacturing, 30%; chemical and pigments, 25%; and other, 10%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Refinery	141	252	243	354	290
Imports for consumption, metal and compounds	284	312	347	297	440
Exports, metal, waste, and scrap	82	61	117	93	130
Consumption, apparent	343	459	538	578	590
Price, average, dollars per pound, 100-pound lots, commercial grade	1/10.95	4.38	3.53	3.87	10
Stocks, producer, yearend	284	293	254	153	105
Employment		Not available			
Net import reliance 2/ as a percent of apparent consumption	59	45	55	39	51

3. Recycling: Due to the high cost of recovery and the decrease in price of old scrap in 1981, domestic production of secondary selenium was discontinued in 1982 and none has been produced since that date. Old scrap, mostly from xerographic material, was exported for processing to recover the selenium. An estimated 100 tons of the selenium metal imported in 1984 were of secondary origin.

4. Import Sources (1980-83): Canada 42%, United Kingdom 15%, Japan 14%, Belgium-Luxembourg 7%, Other 22%.

5. Tariff

	Number	Most Favored Nation (MFN)		Non-NFM
		1/1/85	1/1/87	1/1/85
Selenium metal	632.40	Free	Free	Free
Selenium dioxide and salts	420.50 & 420.52	Free	Free	Free
Other selenium compounds	420.54	4.0% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Represents average producer price; other prices are average dealer prices.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.
4/ Excluding other market economy countries and centrally planned economies.

Prepared by Daniel L. Edelstein, telephone number (202) 634-1053.

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8. Events, Trends and Issues: Domestic production of refined selenium decreased by 22% from the 1983 level, and, much of the production was from stocks of semirefined material. The decrease was offset by a 48% increase in imports. The U.S. dealer price for commercial-grade selenium was $4.00-$4.50 in January and rose to $10.00-$11.25 in March. This large increase resulted from an increase in demand, from speculative buying, and from the decrease in domestic copper production. From a 1978 base, demand for selenium is expected to increase at an average annual rate of about 2% through 1990. It is estimated that in 1985 domestic refinery production of selenium will be 300 tons and U.S. apparent consumption will be 600 tons.

9. World Plant Production and Reserve Base:

	Plant Production		Reserve Base 3/
	1983	1984 e/	
United States	354	290	20,000
Belgium	60	60	-
Canada	295	290	20,000
Chile	23	25	21,000
Finland	10	10	-
Japan	433	400	-
Mexico	30	30	3,000
Peru	22	20	7,000
Sweden	44	50	-
Yugoslavia	24	35	1,000
Zambia	22	25	7,000
Other Market Economy Countries	NA	NA	26,000
Centrally Planned Economies	NA	NA	13,000
World Total (rounded)	4/1,320	4/1,240	120,000

10. World Resources: In addition to the above large reserve base of byproduct selenium which is contained in identified copper deposits of economic grade, 2.5 times this quantity of byproduct metal is believed to exist in other metal deposits and in copper or other metal deposits that are undeveloped, of uneconomic grade, or as yet undiscovered. Coal contains an average of 1.5 parts per million of selenium, but although the selenium content of coal deposits is about 80 times the content of identified economic copper deposits, recovery of selenium from coal appears unlikely in the foreseeable future.

11. Substitutes: High-purity silicon is the major substitute for selenium in its application as a semiconductor in rectifiers, and has already taken over selenium rectifier usage in high-voltage equipment. Other inorganic semiconductor materials, such as silicon, cadmium, tellurium, gallium, and arsenic, as well as organic photoconductors, may substitute for selenium in photoelectric applications. Other substitutes include cerium oxide in glass manufacturing, tellurium in pigment and rubber compounding, and tellurium, bismuth, and lead in the production of free-machining metals.

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SILICON

(Data in thousand short tons of silicon content, unless noted)

1. Domestic Production and Use: Estimated value of silicon metal and alloys (excluding semiconductor grade silicon) produced in the United States in 1984 was $470 million. Ferrosilicon was produced by 10 companies in 16 plants; 6 companies produced approximately 90% of the total. Production of silicon metal was divided among 7 companies in 10 plants. Most of the ferrosilicon and silicon metal plants were located east of the Mississippi River or in the Pacific Northwest. Most ferrosilicon was consumed in the ferrous foundry and steel industries located predominantly in the eastern half of the United States. The main consumers of silicon metal were aluminum producers located throughout the United States and the chemical industry. End uses of silicon were: Transportation, 31%; chemicals, 18%; machinery, 17%; construction, 14%; and other, 20%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	483	476	279	333	440
Imports for consumption	68	139	78	133	130
Exports	28	17	10	9	24
Consumption, apparent	524	575	363	480	550
Price, average, cents per pound Si:					
Ferrosilicon 50% Si	42.0	46.1	45.3	42.1	42.9
Silicon metal max. 1% Fe	59.5	64.9	62.4	57.2	60.3
Stocks, producer and consumer, yearend	102	125	109	86	79
Employment, plant e/	3,500	3,500	2,500	2,500	2,800
Net import reliance 1/ as a percent of apparent consumption	8	17	23	31	21

3. Recycling: Insignificant.

4. Import Sources (1980-1983): Canada 23%, Brazil 22%, Norway 16%, Venezuela 11%, Other 28%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ferrosilicon, 8-60% Si	606.35	Free	Free	2.0¢/lb. Si
Ferrosilicon, 60-80% Si:				
Over 3% Ca	606.36	1.1% ad val.	1.1% ad val.	11.5% ad val.
Other	606.37	1.6% ad val.	1.5% ad val.	11.5% ad val.
Ferrosilicon, 80-90% Si	606.39	1.9% ad val.	1.9% ad val.	9.0% ad val.
Ferrosilicon, over 90% Si	606.40	7.2% ad val.	5.8% ad val.	40.0% ad val.
Silicon, 96.0-99.0% Si	632.86	9.0% ad val.	9.0% ad val.	45.0% ad val.
Silicon, 99.0-99.7% Si	632.42	5.3% ad val.	5.3% ad val.	21.0% ad val.
Silicon, over 99.7% Si	632.43	4.0% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: Quartzite, 14% (Domestic and Foreign); gravel, 5% (Domestic and Foreign).

7. Government Stockpile:

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 months
Silicon carbide, crude short tons, gross weight	29,000	80,550	0	-

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.

Prepared by G. F. Murphy, telephone number (202) 634-1024.

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8. Events, Trends, and Issues: Demand for silicon metal and alloys in the United States is directly related to activity in the iron and steel, aluminum, and chemical industries. Reflecting this demand, prices declined for ferrosilicon early in 1984, but partially recovered in midyear. Silicon metal containing 1% iron and 0.7% calcium, which increased from 52.0¢ to 60.25¢ per pound in July 1983, remained unchanged in 1984. The price of regular grade 50% ferrosilicon declined from 43.0¢ to 39.0¢ per pound of contained silicon on January 5, increased to 41.0¢, 43.0¢, and 45.0¢ on March 22, May 1, and July 1, respectively, and remained at 45.0¢ through yearend. Demand for ferrosilicon increased moderately in 1984 due to a moderate recovery of the iron and steel industry. Silicon metal demand was slightly stronger than that for ferrosilicon, primarily due to increased demand by the aluminum and chemical industries. From a 1983 base, demand for silicon is expected to increase at an average annual rate of about 3.7% through 1990. It is estimated that in 1985 domestic production of silicon metal and alloys will be 350,000 tons and U.S. apparent consumption will be 520,000 tons.

On January 24, the International Trade Commission found that imports of Soviet origin 50% ferrosilicon during the second half of 1983 did not significantly harm the domestic ferroalloy industry. The Commission had been requested, by the U.S. Trade Representative, to conduct an investigation under Section 406 of the Trade Act of 1974 to determine whether the Soviet ferrosilicon imports have caused market disruptions. The Department of Commerce (DOC) released a statement on May 10, that the President had determined that imports of ferroalloys do not threaten the national security. The Ferroalloys Association had petitioned the Government in August 1981 for import relief under the National Security Clause (Sec. 232) of the Trade Act of 1962. Additionally, higher U.S. import duties for seven ferroalloys were deleted from the Omnibus Trade Bill on October 5, 1984, by House-Senate Conferees and an amendment to the Senate version of the bill (S. 3398) that would have imposed a minimum "fair price" or "breakpoint" was struck out.

Federal funding budgeted for photovoltaic research amounted to $57.0 million for 1985. DOC continued controls on exports to the U.S.S.R. of both electronic-grade polycrystalline and monocrystalline silicon.

9. World Production and Reserve Base:

	Production		Reserve Base 2/
	1983	1984 e/	
United States	333	440	The reserve base in most major producing countries is ample in relation to demand. Quantitative estimates are not available.
Brazil	140	150	
Canada	102	100	
France	167	170	
Italy	63	60	
Japan	128	130	
Norway	367	380	
South Africa, Republic of	106	110	
Spain	72	70	
Yugoslavia	106	110	
Other Market Economy Countries	339	350	
U.S.S.R.	549	550	
Other Centrally Planned Economies	324	330	
World Total	2,796	2,950	

10. World Resources: World and domestic resources for making silicon metal and alloys are abundant, but these deposits are not always near market areas. Resources in most alloy metal producing countries are adequate to supply world requirements for many decades.

11. Substitutes: Various metals and alloys, such as aluminum and silicomanganese, can be substituted for silicon in some applications. Germanium is the principal substitute for silicon in semiconductor and infrared applications.

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SILVER

(Data in million troy ounces of silver content, unless noted)

1. Domestic Production and Use: Silver was produced from about 170 mines in 16 States and had an estimated value of $363 million. Five States accounted for 87% of the 1984 mine production: Idaho, 46%; Montana, 13%; Utah, 10%; Arizona, 9%; and Nevada, 9%. Ten mines produced about 65% of the silver mined. There were 22 principal refiners of commercial-grade silver, located primarily in northeastern States. Fabricating and manufacturing firms were estimated to number over 5,000. The photographic industry is located primarily in New York and most other end-use manufacturing firms are mainly in Connecticut, New York, Rhode Island, and New Jersey. Silver consumption in 1984 by end use was: Photography, 48%; electrical and electronic products, 25%; sterlingware, electroplated ware, and jewelry, 11%; brazing alloys and solders, 5%; and other, 11%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	32.3	40.7	40.2	43.4	44.0
Refinery--Primary	39.4	47.0	44.2	50.4	51.0
Secondary (old scrap)	53.1	39.1	27.2	25.5	23.0
Imports for consumption 1/	78.8	94.1	117.5	179.9	120.0
Exports 1/	80.9	27.9	25.5	32.0	25.0
Shipments from Govt. stockpile excesses	-	2.0	-	-	-
Consumption: Reported--Industrial	124.7	116.7	118.8	116.3	118.0
Coinage	0.1	0.2	1.8	2.1	3.0
Apparent 2/	91.2	168.6	150.0	176.2	170.0
Price, average New York, dollars per ounce	20.63	10.52	7.95	11.44	8.25
Stocks, yearend: Treasury Department 3/	38.9	38.7	36.8	34.6	31.0
Industry, COMEX, CBT 4/	138.1	117.4	126.6	168.9	160.0
Department of Defense	4.5	3.8	1.8	0.1	1.0
Employment, mine and mill 5/	2,400	3,600	2,900	2,400	2,600
Net import reliance 6/ as a percent of apparent consumption	7	53	55	61	61

3. Recycling: About 23 million ounces of silver was recovered from old scrap in 1984, equivalent to 19% of reported consumption. Another 38 million ounces were recovered from new scrap.

4. Import Sources (1980-83): Canada 29%, Mexico 20%, Peru 18%, United Kingdom 17%, Other 16%.

5. Tariff: No duties were imposed on imports of unrefined silver or refined bullion. There were duties on items such as platinum- and gold-plated unwrought or semimanufactured silver, but these items constituted a minor portion of U.S. imports.

6. Depletion Allowance: 15% (Domestic), 14% (Foreign).

7. Government Stockpile:

	Stockpile Status--11-30-84			
Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Silver	-	137.5	10.0	-

e/ Estimated.
1/ Excludes coinage.
2/ Domestic primary metal production plus recovery from old silver scrap and net import reliance and includes net bullion purchased for investment purposes.
3/ Balance in Mint only.
4/ Industry: Refiner, fabricator, and dealer. COMEX: Commodity Exchange, Inc., New York. CBT: Chicago Board of Trade.
5/ Source, Mine Safety and Health Administration.
6/ Defined as imports - exports + adjustment for Government and industry stock changes.
7/ Includes silver recoverable as a byproduct of base-metal ores.
8/ See page 180 for definitions.

Prepared by R. G. Reese, telephone number (202) 634-1054.

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8. Events, Trends, and Issues: U.S. production of silver increased slightly in 1984 over that of 1983 despite generally lower silver and other base metal prices, and a nearly stagnant industrial demand for silver. Increased productivity, production from new mines, and a shifting of emphasis at some operations to precious metals recovery were among the factors that contributed to the increased production. The amount of silver supplied to the U.S market in 1984 from domestic primary and secondary sources and imports exceeded U.S. industrial demand. The oversupply of silver to the domestic market is expected to continue in 1985 because of the need by some developing countries to continue to export silver to earn foreign exchange. Since 1980, when silver prices peaked, U.S. industrial consumption has stagnated at about 120 million ounces per year, owing partly to more efficient use of silver in response to high prices.

Speculator and investor activity, as distinguished from industrial demand, continued to be the primary determinant of silver price movements in 1984. Among the factors believed to have influenced speculator-investor activity were the increased value of the U.S. dollar in terms of foreign currencies, relatively high U.S. interest rates, and a low domestic inflation rate. The silver price began the year at $8.58 per ounce and reached the peak for the year of $10.04 on March 5. The price remained in the $8.00-$10.00 range until July 5. The price fell to a low of $6.90 on July 27, after which it rose and remained in the $7.00-$8.00 range until yearend. The average daily price declined from $11.44 in 1983 to $8.25 per ounce in 1984.

Trading activity in U.S. futures markets continued to increase over the record levels of 1983. In 1983, contracts representing an average of over 2.9 billion ounces of silver were traded each month on COMEX, the CBT, and the Mid America Commodity Exchange. In 1984, the average number of silver contracts traded each month on these three exchanges represented nearly 3.3 billion ounces. In October 1984, COMEX introduced and began trading silver options. Each option entitles the holder to either buy or sell one COMEX futures contract representing 5,000 ounces of silver at a given price for a certain period of time.

It is estimated that in 1985 domestic mine production of silver will be 43 million ounces and U.S. apparent consumption will be 150 million ounces. From a 1981 base, demand for silver is expected to increase at an average annual rate of 2.2% through 1990.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 7/8/
	1983	1984 e/	
United States	43.4	44.0	1,800
Canada	35.6	38.0	1,400
Mexico	61.4	62.0	1,400
Peru	55.9	58.0	950
Other Market Economy Countries	113.6	115.0	3,200
U.S.S.R.	47.2	48.0	1,600
Other Centrally Planned Economies e/	33.5	33.0	400
World Total (may be rounded)	390.6	400.0	10,800

10. World Resources: Approximately two-thirds of world silver resources are associated with copper, lead, and zinc deposits. The remaining one-third is in vein deposits in which silver is the principal metallic component. While recent high prices of silver have led to increased exploration and new discoveries, most significant increases in reserves and resources are expected to come from major base metal discoveries that contain byproduct silver.

11. Substitutes: Aluminum and rhodium substitute for silver in mirrors and other reflecting surfaces. Tantalum can be used in place of silver for surgical plates, pins, and sutures. Stainless steel is an alternate material used widely in the manufacture of table flatware. Some of the batteries being developed may replace silver batteries in some applications. Silverless black and white film, film with reduced silver content, and xerography are alternatives to some uses of silver in photography.

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SODIUM CARBONATE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Five companies in Wyoming and one in California comprised the natural soda ash industry. Their combined annual nameplate capacity was about 11.2 million tons. Synthetic soda ash was produced at Syracuse, N.Y., by one company with a 700,000-ton-per-year capacity. Sodium sulfate, potassium chloride, potassium sulfate, borax, and other minerals were produced as coproducts from sodium carbonate production in California. The total estimated value of domestic soda ash produced in 1984 was $590 million.

   Nearly 51% of the soda ash was used for manufacturing glass. The chemical industry consumed 20%; soaps and detergents, 9%; water treatment 3%; pulp and paper, 3%; and other, 14%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production, natural and synthetic	8,275	8,281	7,819	8,467	8,350
Imports for consumption	18	12	18	20	20
Exports	1,094	1,051	1,109	1,636	1,580
Consumption, apparent (natural and synthetic)	7,134	7,112	6,667	6,868	6,790
Prices: Quoted, yearend, soda ash, natural, dense, bulk, f.o.b. Green River, WY, dollars per ton	86.00	92.00	84.00	69.00	73-79
F.o.b. Searles Valley, CA, same basis	90.25	106.25	107.25	92.25	96-102
F.o.b. Syracuse, NY, synthetic, same basis	112.00	132.00	132.00	132.00	132.00
Average sales value (natural source), f.o.b. mine or plant, dollars per ton	89.85	91.19	88.35	76.95	70.00
Stocks, producer, yearend	133	263	324	307	310
Employment, mine and plant	3,600	3,650	3,300	3,400	2,950
Net import reliance 1/ as a percent of apparent consumption		Net exporter			

3. Recycling: There is no recycling of soda ash by producers; however, container glass producers are using cullet glass, thereby reducing soda ash consumption.

4. Import Sources (1980-83): Canada 99%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Calcined (soda ash)	420.84	1.2% ad val.	1.2% ad val.	8.5% ad val.
Hydrated and sesquicarbonate	420.86	0.2¢/lb.	0.1¢/lb.	0.25¢/lb.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign). For natural only.

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ The reported quantities are sodium carbonate only. About 1.8 tons of trona yields 1 ton of sodium carbonate.
3/ See page 180 for definitions.
4/ From trona, nahcolite, and dawsonite sources.
5/ Excluding Botswana and Uganda.
6/ Excluding Botswana, Chad, Kenya, and Uganda.

Prepared by J. P. Searls, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: The European Economic Community Commission announced provisional duties on imports of U.S. soda ash into member countries. Australia commenced a dumping investigation concerning its imports of U.S. soda ash. The U.S. industry appears to have greater potential for growth in export rather than domestic markets. As Canada and Europe have barriers to soda ash imports, the most promising markets would appear to be south and west of the United States. The industry had reorganized a Webb-Pomerene Association, called the American Natural Soda Ash Corporation (ANSAC), to present a unified effort in exporting. A synthetic soda ash project in Thailand was suspended when a study reported that U.S. soda ash could be imported at lower cost than a domestic synthetic plant would afford. A U.S. company is commencing an investigation of a natural soda ash (trona) resource in Turkey and a company in the United Kingdom is considering the brines in northeast Botswana for development.

Successful trials of sodium-based flue gas desulfurization continue to be performed. A medium-size coal-fired power plant has been committed to this technology before the plant is off the drawing board.

Minor sodium leasing rule changes have been announced by the Bureau of Land Management. The Wyoming Environmental Quality Council issued a permit for a domestic firm to commence full-scale trials of trona solution mining.

From a 1983 base, demand for soda ash is expected to increase at an average annual rate of about 1% through 1990. It is estimated that in 1985 domestic mine production of sodium carbonate will be 8.4 million tons and U.S. apparent consumption will be 6.8 million tons.

9. World Mine Production and Reserve Base:

(Natural sources):	Mine Production 1983	Mine Production 1984 e/	Reserve Base 2/ 3/
United States (includes synthetic)	8,467	8,350	42,700,000 4/
Botswana	NA	NA	NA
Chad	6	6	NA
Kenya	165	150	NA
Mexico (includes synthetic)	440	440	500,000
Uganda	NA	NA	NA
World Total (may be rounded)	5/ 9,100	5/ 8,950	6/ 43,200,000

10. World Resources: Soda ash is obtained from trona and sodium carbonate-rich brines. The world's largest deposit of trona is in the Green River Basin of Wyoming. About 52 billion tons of identified soda ash resources could be obtained from the 62 billion tons of bedded trona 2/ and the 52 billion tons of interbedded or intermixed trona and halite that are in beds more than 4 feet thick. About 37 billion tons of reserve base soda ash could be obtained from the 40 billion tons of halite-free trona and the 27 billion tons of inter-bedded or intermixed trona and halite that are in beds more than 6 feet thick. Two potential sources of soda ash, nahcolite (sodium bicarbonate) and dawsonite (sodium aluminum-carbonate), are associated with oil shale in northwest Colorado. Identified resources of 32 billion tons of nahcolite and 19 billion tons of dawsonite (equivalent to 27 billion tons of sodium carbonate resources) are available as a byproduct of oil shale processing.

There are at least 61 identified natural sodium carbonate deposits in the world, some of which have been quantified. The countries and number of deposits include: Bolivia (2), Botswana (1), Brazil (1), Canada (3), Chad (1), China (9), Egypt (1), Ethiopia (1), India (2), Kenya (3), Mexico (1), Namibia (1), Niger (1), Pakistan (1), the Republic of South Africa (1), Tanzania (5), Turkey (1), Uganda (1), the U.S.S.R. (4), the United States (20), and Venezuela (1).

11. Substitutes: Caustic soda can be substituted for soda ash in certain uses. An alternate source of soda ash is nahcolite, but commercial development of oil shale mining with byproduct nahcolite and dawsonite recovery is uncertain.

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SODIUM SULFATE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The domestic production of natural sodium sulfate rose in 1984 compared with that of 1983 while apparent consumption declined. About 46% of the U.S. sodium sulfate production was a byproduct from various chemical and rayon manufacturing plants. Total production of sodium sulfate was valued at about $90 million in 1984. Three producers of natural sodium sulfate started the year with four plants in California, Texas, and Utah. The major end uses of sodium sulfate were detergents, 47%; pulp and paper, 36%; and glass and miscellaneous, 17%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Natural	583	608	1/ 864	423	530
Synthetic 2/	556	503	-	432	450
Imports for consumption	230	275	394	343	180
Exports	129	124	111	91	120
Consumption, apparent (natural and synthetic)	1,236	1,229	1,183	1,089	1,020
Price: Quoted, sodium sulfate-100% Na_2SO_4, bulk, f.o.b. works, East, dollars per ton	78.00	78.00	103.00	103.00	113
Average sales value (natural source), f.o.b. mine or plant, dollars per ton	62.42	71.03	83.30	93.30	90
Stocks, producer, yearend, natural	33	66	30	48	70
Employment, wells and plants	500	500	450	450	450
Net import reliance 3/ as a percent of apparent consumption	8	10	27	21	4

3. Recycling: There was some recycling of sodium sulfate by consumers, particularly in the pulp and paper industry, but no recycling by sodium sulfate producers.

4. Import Sources (1980-83): Canada 91%, Belgium 3%, Mexico 3%, Other 3%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude (salt cake)	421.42	Free	Free	Free
Anhydrous	421.44	36¢/l.t.	33¢/l.t.	$3/l.t.
Crystallized (Glauber's salt)	421.46	2.7% ad val.	2.5% ad val.	4% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign)--natural only.

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Includes synthetic sodium sulfate because natural sodium sulfate production data were withheld in 1982 to avoid revealing company proprietary data.
2/ Source: U.S. Bureau of the Census.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.

Prepared by J. P. Searls, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: Domestic consumption of sodium sulfate decreased in 1984 because the pulp and paper industry substituted emulsified sulfur and caustic soda. Byproduct (synthetic) production of sodium sulfate increased as the producing industries responded to the increasing demand for their primary products. Imports decreased while exports and stocks increased. A major detergent merchandizer announced plans to use less sodium sulfate in its formulation starting in 1985.

   The natural sodium sulfate producer in Utah was forced to suspend production in early May when its harvesting ponds were flooded by the Great Salt Lake. That producer, a relatively small one, may not restart for several years. The relatively new hydrochloric acid plant in Crantsville, UT was reportedly under consideration for conversion from sodium sulfate byproduct production to potassium sulfate byproduct production.

   It is estimated that in 1985 domestic mine production of sodium sulfate will be 500,000 tons and U.S. apparent consumption will be 990,000 tons. From a 1983 base, demand for sodium sulfate is expected to increase at an average annual rate of about 1.4% through 1990.

9. World Mine Production and Reserve Base: (Natural sources)

	Mine production		Reserve Base 4/
	1983	1984 e/	
United States	423	530	1,500,000
Argentina	50	50	NA
Canada	490	450	300,000
Iran	14	10	NA
Mexico	166	150	250,000
Spain	310	300	300,000
Turkey	77	80	NA
Other Market Economy Countries	5	10	250,000
U.S.S.R.	397	400	2,500,000
World Total	1,932	1,980	5,100,000

10. World Resources: Sodium sulfate resources are sufficient to last hundreds of years at the present rate of world consumption. In addition to the above countries, identified resources of sodium sulfate exist in Botswana, Egypt, Italy, Mongolia, Romania, and the Republic of South Africa.

11. Substitutes: In pulp and paper, emulsified sulfur and caustic soda can replace sodium sulfate. In detergents, a variety of products can substitute for sodium sulfate. In glassmaking, soda ash or calcium sulfate have been substituted for sodium sulfate with less than perfect results.

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STONE (CRUSHED) 1/
(Data in million short tons, unless noted)

1. Domestic Production and Use: Crushed stone valued at $3.8 billion was produced by 1,800 companies operating 3,800 quarries in 48 States. Leading States were Texas, Florida, Pennsylvania, Georgia and Illinois, which accounted for nearly 31% of the output. About 65% of this tonnage was used as construction aggregate, mostly for highway and road construction and maintenance; 12% was used for cement and lime manufacturing; 2% in agriculture; 1% for metallurgical process, 2% for a variety of industrial uses, and other, 18%. Of the crushed stone produced in 1984, about 72% was limestone and dolomite, 14% granite, 9% traprock, 2% sandstone, and the remaining 3% was shell, marl, volcanic cinder, slate, and other.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production	984	873	790	863	950
Imports for consumption	4	3	2	2	2
Exports	3	4	2	2	2
Consumption, apparent	985	872	790	863	950
Price: Average value, dollars per ton	3.32	3.58	3.89	3.87	3.85
Stocks, yearend		Not available			
Employment, quarry and mill 2/	54,000	52,000	51,000	52,000	53,000
Net import reliance 3/ as a percent of apparent consumption			None		

3. Recycling: Asphalt-crushed stone road surfaces and, to a lesser extent, cement concrete surfaces were recycled on a limited but increasing basis in some States.

4. Import Sources (1980-83): Canada 55%, Bahamas 9%, Other 36%.

5. Tariff: Crushed stone rates will vary from free to 1.3% ad valorem for most favored nations and to 30% ad valorem from non-most favored nations in 1985 according to the type of stone and use. Ad valorem rates for most favored nations are scheduled to decrease through 1987.

6. Depletion Allowance: (Domestic and Foreign) 14% for chemical and metallurgical uses; 5% if used for riprap, ballast, road material, rubble, concrete aggregate, and similar purposes.

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ See also Stone (Dimension).
2/ Excluding office staff.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.

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8. Events, Trends, and Issues: Crushed stone output increased in 1984 by about 10%. It is estimated that 1985 domestic production and U.S. apparent consumption will be about 975 million tons each. From a 1980 base, demand for crushed stone is expected to increase at an average annual rate of 1.0% through 1990, giving a probable forecast demand in 1990 of 1.1 billion tons.

   The crushed stone industry continued to be concerned with safety regulations and environmental restrictions. Shortages in some urban and industrialized areas were expected to continue to increase due to local zoning regulations and land development alternatives. This was expected to continue to cause a relocation of crushed stone quarries from high population centers.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1983	1984 e/	
United States	863	950	Adequate except for certain special types and local shortages.
Other Countries	NA	NA	

10. World Resources: Stone resources of the world are practically inexhaustible. High-purity limestone and dolomite suitable for chemical and metallurgical use are limited in many geographical areas. The largest resources of high-purity limestone and dolomite in the United States are in the central and eastern parts of the country.

11. Substitutes: Crushed stone substitutes for roadbuilding include sand and gravel and slag. Substitutes for aggregate include sand and gravel, slag, sintered or expanded clay or shale, and perlite or vermiculite.

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STONE (DIMENSION) 1/

(Thousand short tons and million dollars)

1. Domestic Production and Use: Dimension stone totaling 1.23 million tons valued at $155 million was produced by 220 companies at 300 quarries in 31 States. It was used in construction of buildings, 42%; and monuments, 27%; the remainder was used as rubble, 13%; flagging, 4%; curbing, 4%; and other, 10%. Leading producing States were Georgia, North Carolina, and Indiana, which accounted for about 40% of the output. Of the total, 52% was granite, 21% was limestone, 12% was sandstone, 4% was slate, 3% was marble, and 8% was other.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Tonnage	1,315	1,331	1,330	1,186	1,227
Value	139	150	145	149	155
Imports for consumption, value	89	133	170	195	229
Exports, value	15	21	19	21	26
Consumption, apparent, value	213	262	296	323	358
Price	Variable, depending on type of product				
Stocks, yearend	Not available				
Employment, quarry and mill 2/	3,300	3,300	3,200	3,000	3,000
Net import reliance 3/ as a percent of apparent consumption (based on value)	35	43	51	54	57
Granite, only, tonnage:					
Production	662	682	681	616	638
Imports for consumption	160	100	110	120	490
Exports	91	88	83	88	75
Consumption, apparent	731	694	708	648	1,053
Price	Variable, depending on type of product				
Stocks, yearend	Not available				
Employment: Quarry and mill 2/	1,700	1,700	1,600	1,500	1,500
Net import reliance 3/ as a percent of apparent consumption (based on tonnage)	9	2	4	5	39

3. Recycling: Small amounts of dimension stone are recycled, principally by restorers of old stone work.

4. Import Sources (1980-83): (based on value) Dimension stone: Italy 72%, Canada 10%, Mexico 2%, Portugal 2%, Other 14%. Granite only: Italy 66%, Canada 23%, Other 11%.

5. Tariff: Dimension stone tariffs will vary from free to 9.4% ad valorem for most favored nations in 1985 according to type, size, value, and degree of preparation. Ad valorem rates for most favored nations are scheduled to decrease during 1986-87.

e/ Estimated. NA Not available.
1/ See also Stone (Crushed).
2/ Excluding office staff.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 180 for definitions.

Prepared by Harold A. Taylor, Jr., telephone number (202) 634-1180.

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6. Depletion Allowance: (Domestic and Foreign) 14%; 5% if used for rubble, and other nonbuilding purposes.

7. Government Stockpile: None.

8. Events, Trends, and Issues: Dimension stone imports increased significantly for the fourth successive year to a value of $229 million in 1984. Value of imports exceeded that of production for the third successive year. From a 1980 base, demand for dimension stone is expected to increase at an average annual rate of about 1% through 1990. It is estimated that in 1985 domestic production of dimension stone will be 1.2 million tons and U.S. apparent consumption will be valued at $350 million.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1983	1984 e/	
United States	1,186	1,227	Adequate except for
Other countries	NA	NA	certain special types
World total	NA	NA	and local shortages.

10. World Resources: Dimension stone resources of the world are inexhaustible. Resources can be limited on a local level, or occasionally on a regional level, by the lack of a particular kind of stone or a lack of a given stone that is suitable for dimension purposes.

11. Substitutes: Substitutes for dimension stone include concrete, steel, aluminum, resin agglomerated stone and plastics.

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STRONTIUM

(Data in short tons of contained strontium, unless noted)

1. Domestic Production and Use: Domestic consumption of strontium compounds in 1984 was valued at an estimated $16.8 million. Consumers of strontium minerals and compounds continued to depend totally on imports for supply, as the domestic strontium mining industry has been dormant since 1959. Mexico and the Federal Republic of Germany were the chief suppliers of celestite and strontium compounds, respectively, to the U.S. market. By midyear 1984, only one U.S. company, located in Georgia, was a major producer of strontium compounds. Primary strontium compounds were used in the manufacture of glass for color television picture tube faceplates, 64%; pyrotechnics and signals, 14%; ferrite ceramic permanent magnets, 5%; and other uses, 17%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production, strontium minerals			None		
Imports for consumption:					
Strontium minerals	16,960	21,800	14,500	21,800	23,300
Strontium compounds	1,640	2,500	1,100	500	700
Exports (celestite and compounds)	1/NA	3,000	300	1/NA	1/NA
Shipments from Govt. stockpile excesses	-	-	-	-	-
Consumption, apparent (celestite and compounds)	18,040	19,200	16,700	22,700	24,000
Price, average value of mineral imports at port of exportation, dollars per ton	55.56	64.51	62.19	74.42	70.00
Stocks, consumer, yearend (celestite only)	5,600	7,700	6,300	5,900	5,900
Net import reliance 2/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1980-83): Mexico 95%, Spain, 5%. Minerals only.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Compounds:				
Carbonate:				
Not precipitated	421.70	Free	Free	Free
Precipitated	421.72	4.7% ad val.	4.2% ad val.	25% ad val.
Nitrate	421.74	4.7% ad val.	4.2% ad val.	25% ad val.
Oxide	421.76	4.7% ad val.	4.2% ad val.	25% ad val.
Minerals:				
Celestite	421.82	Free	Free	Free
Other	421.84	4.0% ad val.	3.7% ad val.	25% ad val.
Other	421.86	4.0% ad val.	3.7% ad val.	25% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. NA Not available.
1/ Export data are not available and are assumed to be zero for net import reliance and apparent consumption calculations.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.
4/ Excluding China and the U.S.S.R.

Prepared by J. E. Ferrell, telephone number (202) 634-1177.

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7. Government Stockpile:

Stockpile Status--11-30-84				
Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Celestite	-	5,903	5,903	-

8. Events, Trends, and Issues: World production of strontium increased an estimated 10% in 1984 compared with that of 1983. The United States, totally reliant on imports of strontium minerals, imported mainly from Mexico about 34% of the 1984 world production of celestite. U.S. imports of strontium compounds were mainly from the Federal Republic of Germany in 1984.

One of the two major U.S. strontium compound producers closed its plant in 1984. The other major producer expanded its strontium carbonate capacity by 30% to meet any potential shortfall in supply that might result from the plant closure. In a similar vein, the world's largest strontium carbonate producer, located in the Federal Republic of Germany, announced plans to expand its plant capacity by one-third in early 1985.

From a 1983 base, demand for strontium is expected to increase at an average annual rate of about 1.6% through 1990. It is estimated that in 1985 there will be no domestic production of stontium minerals and U.S. apparent consumption will be 24,500 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	-	-	1,500,000
Algeria	1,500	1,500	
Argentina	390	400	
Iran	2,400	2,400	
Italy	1,500	1,500	
Mexico	19,000	22,000	Other:
Pakistan	150	200	11,700,000
Spain	17,000	20,000	
Turkey	7,300	7,300	
United Kingdom	8,700	8,700	
World Total 4/ (may be rounded)	58,000	64,000	13,200,000

10. World Resources: Resources in the United States are several times the reserve base. World resources, although not thoroughly evaluated, are believed to exceed 1 billion tons.

11. Substitutes: Although it is possible to substitute for strontium in some of its applications, to do so would adversely affect performance and/or cost. For example, barium could replace strontium in color television tube glass only after extensive circuit redesign to reduce operating voltages that produce harmful secondary X-rays. Barium replacement of strontium in ferrite ceramic permanent magnets would decrease the maximum energy and temperature characteristics of the magnet. Substituting for strontium in pyrotechnics would be impractical because the desired brilliance and visibility are imparted only by strontium and its compounds.

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SULFUR

(Data in thousand metric tons of sulfur, unless noted)

1. Domestic Production and Use: In 1984, sulfur was produced at 193 operations in 32 States, Puerto Rico, and the Virgin Islands for a total shipment value of $1.1 billion. Texas and Louisiana accounted for 56% of production. Ten companies with 60 operations accounted for 73% of production. Frasch sulfur was produced in Texas and Louisiana by 4 companies operating 6 mines, with the 3 largest mines accounting for 33% of domestic production in all forms. Recovered elemental sulfur was produced as a coproduct at petroleum refineries, natural gas operations, and coking plants in 26 States, Puerto Rico, and the Virgin Islands by 58 companies with 155 individual plants. Sulfur was also produced in the form of sulfuric acid, pyrites, hydrogen sulfide, and sulfur dioxide in 18 States by 12 companies with 32 operations. Sulfur shipped for domestic consumption was obtained mainly from domestic sources: Recovered, 40%; Frasch, 31%; and combined coproduct sulfuric acid, pyrites, hydrogen sulfide, and sulfur dioxide, 9%. The remaining 20% of the sulfur was obtained by imports of Frasch and recovered sulfur. About 85% of the sulfur was converted to sulfuric acid prior to end use. Agricultural chemicals (fertilizers) accounted for 65% of sulfur demand. Organic chemicals, inorganic chemicals, and other chemical products accounted for 10%, petroleum refining 7%, and metal mining 3% of the sulfur demand. Other uses, 15%, were widespread, as most products produced by industry require sulfur in one form or another during some stage of their manufacture.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Frasch	6,390	6,348	4,210	3,202	4,000
Recovered elemental	4,073	4,259	4,404	4,955	5,200
Other forms	1,403	1,538	1,173	1,133	1,100
Total	11,866	12,145	9,787	9,290	10,300
Shipments, all forms	12,918	11,655	9,115	10,285	11,200
Imports for consumption, Frasch and recovered	2,523	2,522	1,905	1,695	2,400
Exports, Frasch and recovered	1,782	1,392	961	992	1,200
Consumption, apparent, all forms 1/	13,659	12,785	10,059	10,988	12,400
Price, reported average value, dollars per ton of elemental sulfur, f.o.b. mine/plant	89.06	111.48	108.27	90.62	99.00
Stocks, producer, yearend	3,094	3,634	4,202	3,218	2,320
Employment, mine/plant e/	4,000	4,000	3,700	3,700	3,500
Net import reliance 2/ as a percent of apparent consumption	14	5	4	15	17

3. Recycling: About 800,000 tons, sulfur content, of spent acid was reclaimed from petroleum refining and chemical processes.

4. Import Sources (1980-83): Canada, 64%, Mexico, 36%, Other, less than 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Sulfur (crude)	415.45	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 22% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Measured by shipments, plus imports, minus exports.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.

Prepared by D. E. Morse, telephone number (202) 634-1190.

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8. Events, Trends, and Issues: World sulfur production increased in 1984 after 3 consecutive years of decline. World sulfur demand exceeded production by 3 million tons and brought about a remelt of about 2 million tons of Canadian sulfur and stock decreases in the United States and Saudi Arabia. Stimulated by improved domestic and export fertilizer demand, domestic sulfur demand increased nearly 13% from that of 1983 and continued to exceed domestic production. Shipments and production of elemental sulfur from petroleum refineries and natural gas processing plants exceeded 5.0 million tons for the first time and surpassed output and shipments from Frasch mines for the third consecutive year. One Frasch mine in Louisiana was closed during the year, the fifth mine closure in the past 3 years. From a 1983 base, demand for sulfur is expected to increase at an average annual rate of 3.2% through 1990. It is estimated that in 1985 domestic sulfur production will be 10.8 million tons and U.S. apparent consumption will be 12.5 million tons.

The posted price for liquid sulfur ex-terminal Tampa, FL, was increased from $130.41 per ton to $137.78 per ton in May and to $145.17 per ton in late August. Discounting from the posted price, which began in 1983, was continued through 1984. Internationally, long-term contract prices increased about $20 per ton for second half deliveries; spot sulfur prices followed, increasing by $20 per ton in July and because of reduced availability and strong demand by an additional $20 to $30 per ton during August and September. Spot prices stabilized at the higher levels in late September when increased remelt of sulfur from stocks in Canada brought supply and demand into balance.

Domestic production of recovered elemental sulfur from crude oil and sour gas and byproduct sulfuric acid from nonferrous metal smelters is expected to increase substantially by 1990.

9. World Mine Production and Reserve Base:

	Production - All Forms		Reserve Base 3/
	1983	1984 e/	
United States	9,290	10,300	175,000
Canada	6,600	6,500	300,000
France	2,000	1,800	20,000
Germany, Federal Republic of	1,550	1,600	30,000
Italy	450	500	15,000
Japan	2,650	2,700	10,000
Mexico	1,630	1,800	100,000
Spain	1,130	1,200	30,000
Near East	1,450	1,700	500,000
Other Market Economy Countries	4,750	4,900	300,000
Centrally Planned Economies	19,000	19,500	1,250,000
World Total (may be rounded)	50,500	52,500	2,700,000

10. World Resources: Resources of elemental sulfur in evaporite and volcanic deposits and sulfur associated with natural gas, petroleum, tar sands, and metal sulfides amount to about 5 billion tons. The sulfur in gypsum and anhydrite is almost limitless and some 600 billion tons are contained in coal, oil shale, and shale rich in organic matter, but low-cost methods have not been developed to recover sulfur from these sources. The domestic resource is about one-fifth of the world total.

11. Substitutes: There are no adequate substitutes for sulfur at present or anticipated price levels; some acids, in certain applications, may be substituted for sulfuric acid.

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TALC AND PYROPHYLLITE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: There were 29 talc producing mines in 11 States in 1984, the 3 largest supplied 64% of the output. Texas, Montana, New York and Vermont, in order of volume, produced, together, 82% of the yearly total. Ground talc was consumed in ceramics, 35%; paints, 18%; roofing, 11%; paper, 9%; plastics, 6%; cosmetics, 5%; and rubber, 3%. Total pyrophyllite production, 7% of total talc plus pyrophyllite production and all in California and North Carolina, remained static in 1984. Consumption was mainly in ceramics, 32%; refractories, 27%; insecticides, 14%; and roofing, 8%. The talc and pyrophyllite sold was valued at $20.8 million.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	1,240	1,343	1,135	1,066	1,230
Sold by producers	1,331	1,221	1,025	1,163	1,150
Imports for consumption	21	27	27	44	50
Exports	275	311	232	218	230
Shipments from Govt. stockpile excesses	-	-	-	-	-
Consumption, apparent	1,077	937	820	989	1,100
Price: Crude or ground			$15 to $300 per ton		
Stocks, producer, yearend	169	291	401	304	250
Employment: Mine and mill	950	920	880	800	780
Net import reliance 1/ as a percent of consumption			N e t e x p o r t e r		

3. Recycling: Insignificant.

4. Import Sources (1980-83): Canada 34%, Italy 30%, Australia 13%, France 8%, Other 15%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude, not ground	523.31	0.02¢/lb	0.02¢/lb	0.25¢/lb
Ground, washed, powdered	523.33	3.3% ad val.	2.4% ad val.	35.0% ad val.
Cut or sawed	523.35	0.1¢/lb	Free	1¢/lb
Other, n.s.p.f.	523.37	4.8% ad val.	4.8% ad val.	35.0% ad val.

6. Depletion Allowance: Block steatite talc--22% (Domestic), 14% (Foreign).
Other--14% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--11-30-84
(Short tons)

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Talc, block and lump	28	1,081	63	-
Talc, ground	-	1,089	0	-

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 180 for definitions.

Prepared by R. A. Clifton, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: U.S. mine production of talc-group minerals increased 15% compared with that of 1983. Apparent consumption of talc minerals in the United States was 9% higher than in 1983. From a 1979 base, demand for talc and related minerals is expected to increase at an average annual rate of about 3% through 1990. It is estimated that in 1985 domestic mine production of talc will be 1.3 million tons and U.S. apparent consumption will be 1.1 million tons.

U.S. exports of talc minerals had shown cyclical growth in prior years, but the tonnage exported in 1984 was 6% above that in 1983, and the same as 1982.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 2/
	1983	1984 e/	
United States	1,066	1,230	150,000
Finland	330	330	10,000
France	305	320	10,000
Italy	180	180	10,000
Japan	1,614	1,700	60,000
Other Market Economy Countries	2,238	2,400	40,000
Centrally Planned Economies	1,820	2,000	50,000
World Total	7,553	8,160	330,000

10. World Resources: The United States is self-sufficient in most grades of talc and related minerals. Domestic and world resources are estimated to be approximately 5 times the quantity of reserves.

11. Substitutes: In the ceramics market talc and pyrophyllite compete with each other as well as kaolin, fuller's earth, other inorganic fillers, and feldspar. Phosphate-bonded talc is a thoroughly acceptable substitute for block steatite talc; potential alternative materials are talc bonded with magnesium oxychloride, and either phosphate-bonded or hot-pressed synthetic mica. Talc, mica, and other minerals compete for plastic (especially polypropylene) filling and reinforcing roles.

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TANTALUM

(Data in thousand pounds of tantalum content, unless noted)

1. Domestic Production and Use: There has been no significant domestic tantalum mining industry since 1959, except for small unreported quantities of tantalum-bearing concentrates produced in 1980-82. Most metal, alloys, and compounds were produced by seven companies with eight plants; tantalum units were obtained from imported concentrates and tin slags, and from both foreign and domestic scrap. Consumption in the form of metal, powder, ingot, fabricated forms, and compounds and alloys had the following end uses: Electronic components, 62%; machinery, 20%; transportation, 14%; and other, 4%. Total estimated value of domestic shipments of metal, alloys, and compounds was $150 million.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Mine Production	Small	Small	Small	-	-
Imports for consumption: Concentrate, tin slags, and other 1/	2,280	1,580	e/1,087	W	1,300
Exports: Concentrate, metal, alloys, waste, and scrap e/	706	222	340	262	360
Shipments from Government stockpile excesses	-	-	-	-	-
Consumption: Reported, raw material	1,863	1,269	e/800	e/900	1,000
Apparent	1,187	1,262	1,060	1,181	1,200
Price: Tantalite, dollars per pound 2/	103.50	81.50	40.91	25.06	30.70
Industry Stocks: Processor, yearend	3,261	3,452	e/3,195	W	NA
Employment: Processor e/	600	550	500	500	500
Net import reliance 3/ as a percent of apparent consumption	90	92	92	97	94

3. Recycling: Consumption of combined prompt industrial and obsolete scrap was insignificant. Generation of new scrap was estimated to be over 200,000 pounds, most of which was consumed by processors.

4. Import Sources (1980-83): Thailand 38%, Malaysia 10%, Brazil 10%, Canada 8%, Other 34%. Starting at yearend 1982, imports from Canada were negligible.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Potassium fluotantalate	420.3620	3.3% ad val.	3.1% ad val.	25.0% ad val.
Tantalum concentrate	601.4200	Free	Free	Free
Synthetic tantalum/columbium concentrate	603.6700	Free	Free	30.0% ad val.
Tantalum, unwrought:				
Waste and scrap	629.0520	4.0% ad val.	3.7% ad val.	25.0% ad val.
Metal	629.0540	4.0% ad val.	3.7% ad val.	25.0% ad val.
Alloys	629.0700	5.6% ad val.	4.9% ad val.	25.0% ad val.
Tantalum, wrought	629.1000	6.4% ad val.	5.5% ad val.	45.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: In addition to quantities shown, the stockpile contains a negligible quantity in nonstockpile-grade metal and 1,152,000 pounds in nonstockpile-grade minerals. In January 1984, the General Services Administration agreed to purchase 50,000 pounds of contained tantalum as tantalum natural mineral concentrates for the National Defense Stockpile, purchase price being about $35.89 per pound of contained tantalum pentoxide.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Metal, alloys, and synthetic concentrates; exclusive of waste and scrap.
2/ Average value, contained tantalum pentoxide, 60% basis.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Does not include production of tantalum contained in tin slags reported by Tantalum Producers International Study Center (TIC) as 1,049,000 pounds in 1983; data not available for 1984.
5/ See page 180 for definitions.
6/ Excluding Centrally Planned Economies.

Prepared by L. D. Cunningham, telephone number (202) 634-1024.

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Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 months
Carbide powder	-	29	-	-
Metal	-	201	-	-
Minerals	8,400	1,432	-	-

8. Events, Trends, and Issues: Demand for tantalum continued to show signs of recovery, aided by strengthening demand in the capacitor and cemented carbide sectors. Estimated U.S. factory sales of tantalum capacitors rose by about 40% from the 1983 level. Imports for consumption of tantalum concentrates increased nearly threefold from the previous year with Thailand, Australia, and Brazil accounting for over 60% of the total. The spot market price for tantalum concentrates which began the year at about $30 per pound of contained pentoxide was being quoted in the fourth quarter at around $32. Published price quotations for tantalum mill products and powders remained unchanged. Australia's major tantalum producer secured a loan of about $13 million to develop a new tin-tantalum mine in Australia. The company's annual tantalum output is envisioned at about 500,000 pounds starting in 1986.

From a 1983 base, demand for tantalum is expected to increase at an average annual rate of about 3% through 1990. It is estimated that in 1985 domestic mine production of tantalum will be zero and U.S. apparent consumption will be 1.3 million pounds.

New effluent limitations guidelines and standards for nonferrous metals manufacturing, including tantalum, were set by the Environmental Protection Agency (EPA) in the March 8, 1984, Federal Register, Vol. 49, No. 47, Part II. Also, EPA proposed effluent limitations guidelines and standards for nonferrous metals forming operations. The proposal includes tantalum and was being considered in 1984. The regulations are part of EPA's water pollution effluent guidelines program.

There are no known uncontrollable health hazards connected with production or fabrication of tantalum metals and compounds. Fumes, gases, dust, and low-level radiation generated by extraction plants can be controlled by modern technology.

9. World Mine Production and Reserve Base:

	Mine Production e/4/ 1983	Mine Production e/4/ 1984	Reserve Base 5/
United States	-	-	Negligible
Australia	150	200	20,000
Brazil	90	100	3,000
Canada	-	-	5,000
Malaysia	17	20	4,000
Nigeria	16	20	10,000
Thailand	278	250	20,000
Zaire	50	50	10,000
Other Market Economy Countries	77	100	4,000
Centrally Planned Economies	NA	NA	NA
World Total 6/	678	740	76,000

10. World Resources: Most of the world's resources of tantalum occur outside the United States. On a worldwide basis, identified resources of tantalum are considered adequate to meet projected needs. These resources are largely located in Australia, Brazil, Canada, Egypt, Malaysia, Nigeria, Thailand, and Zaire. The United States has about 3.4 million pounds of tantalum resources located in identified deposits, which were considered uneconomic at 1984 prices.

11. Substitutes: The following materials can be substituted for tantalum, but usually with less effectiveness: Columbium in superalloys and carbides; aluminum and ceramics in electronic capacitors; silicon, germanium, and selenium in electrical rectifiers; glass, titanium, zirconium, columbium, and platinum in corrosion-resistant equipment; and tungsten, rhenium, molybdenum, iridium, hafnium, and columbium in high-temperature applications.

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TELLURIUM

(Data in metric tons of tellurium content, unless noted)

1. Domestic Production and Use: Tellurium was recovered as a byproduct from anode slimes generated in the electrolytic refining of copper. One copper refinery located in Texas accounted for all domestic production of tellurium. Tellurium's primary use was as an alloying material in the production of free-machining steels. It was also used as a minor additive in copper and lead alloys and malleable cast iron, as an accelerator in rubber compounding, and as a semiconductor in thermoelectric, thermal imaging, and photoelectric applications. Consumption by major use was estimated as follows: Iron and steel products, 55%; nonferrous metals, 22%; chemicals, 15%; and other, 8%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Refinery	W	W	W	W	W
Imports for consumption	29	38	17	12	45
Exports		Not available			
Consumption, apparent	81	85	46	57	80
Price, dollars per pound, 99.7% min. 1/	19.77	14.00	10.00	9.00	11.00-11.50
Stocks: Producer, refined, yearend	W	W	W	W	W
Employment		Not available			
Net import reliance 2/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1980-1983): Canada 44%, Hong Kong 20%, United Kingdom 12%, Other 24%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Metals	632.48	1.0% ad val.	Free	25.0% ad val.
Compounds	421.90	4.0% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ For 1980, annual average price. The published list price of tellurium was suspended Jan. 5, 1981. Prices beyond 1980 are yearend prices quoted by one producer.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.
4/ Excluding production in the United States, "Other" market economy countries, and centrally planned economies.

Prepared by D. L. Edelstein, telephone number (202) 634-1053.

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8. Events, Trends and Issues: Due to the continued low level of domestic copper production, U.S. production of tellurium in 1984 was essentially the same as in 1983. Demand, however, increased 40% and was met from domestic stocks and an almost threefold increase in imports. The increase in demand for tellurium was attributed to the increase in demand for free-machining steels, primarily in the automobile industry. Domestic dealer prices were quoted at $11.00-11.50 per pound for commercial-grade metal. From a 1983 base, demand for tellurium is expected to increase at an average annual rate of about 1% through 1990. It is estimated that in 1985 U.S. apparent consumption will be 80 metric tons.

9. World Plant Production and Reserve Base:

	Plant production		Reserve Base 3/
	1983	1984 e/	
United States	W	W	6,000
Canada	24	15	2,000
Japan	65	65	-
Peru	21	20	2,000
Other Market Economy Countries	NA	NA	18,000
Centrally Planned Economies	NA	NA	6,000
World Total	4/110	4/100	34,000

10. World Resources: In addition to the above large reserve base of byproduct tellurium contained in identified copper deposits of economic grade, several other sources of byproduct metal exist. The reserve base of lead ore contains about one-fourth the quantity of tellurium occurring in economic copper deposits; however, at present very little lead is refined by the electrolytic method which allows tellurium recovery. Relatively small quantities of tellurium can be recovered from gold telluride ores. Resources of copper and other metals that are undeveloped, of uneconomic grade, or as yet undiscovered, contain several times the quantity of tellurium in identified economic copper deposits. Although coal deposits contain an estimated average of 0.015 part per million tellurium, or a total content about four times that of economic copper deposits, recovery of tellurium from coal appears unlikely in the foreseeable future.

11. Substitutes: The chief materials which can substitute for tellurium include selenium, bismuth, and lead in metallurgical applications, selenium and sulfur in rubber compounding applications, and selenium and germanium in electronic applications.

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THALLIUM

(Data in pounds of thallium content, unless noted)

1. Domestic Production and Use: Thallium is a byproduct recovered from flue dusts and residues collected in the smelting of copper, zinc, and lead ores. Although thallium was contained in ores mined in the United States, thallium metal was not recovered in 1984. It was marketed as thallium compounds, or as metal in the form of sticks, ingots, or wire. The electronics industry consumed about 60% to 70% of the thallium used in 1984. The balance was used principally in pharmaceuticals, alloys, and glass manufacturing.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Refinery	W	W	-	-	-
Imports for consumption 1/	151	755	2,541	2,799	2,800
Exports	Not available				
Consumption, apparent	4,200	2,500	2,500	2,800	2,800
Price, metal, dollars per pound 2/	7.50	7.50	35-45	35-45	35-45
Stocks, producer, yearend	W	W	W	W	W
Employment e/	5	5	-	-	-
Net import reliance 3/ as a percent of apparent consumption	W	W	100	100	100

3. Recycling: Insignificant.

4. Import Sources (1980-83): Belgium-Luxembourg 44%, Federal Republic of Germany 32%, Norway 11%, Japan 11%, Other 2%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Unwrought metal, and waste and scrap	632.50	1.3% ad val.	Free	25% ad val.
Compounds	422.00	4.0% ad val.	3.7% ad val.	25% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Includes thallium contained in compounds.
2/ In 1980-81, domestic producer price. In 1982-84, estimated price of imported metal.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Based on the estimated thallium content of zinc ores.
5/ See page 180 for definitions.

Prepared by P. A. Plunkert, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: As a result of the discontinuance of domestic production of thallium, the United States met its domestic requirements from imports and withdrawals from stocks. From a 1983 base, demand for thallium is expected to show no growth through 1990. It is estimated that in 1985 U.S. apparent consumption of thallium will be 2,800 pounds.

   Thallium is a toxic material and is controlled to prevent a threat to the environment or labor force.

9. World Mine Production and Reserve Base: 4/

	Mine Production e/		Reserve Base 5/
	1983	1984	
United States	1,000	1,000	260,000
Rest of the World	27,000	27,000	1,160,000
World Total	28,000	28,000	1,420,000

10. World Resources: World resources of thallium contained in zinc resources are about 38 million pounds, most of which are in Europe, Canada, and the United States. An additional 1.4 billion pounds are contained in the world's identified resources of coal.

11. Substitutes: While other materials can be substituted for thallium and its compounds in specific applications, ample supplies of thallium discourage development of substitute and alternate materials.

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THORIUM 1/

(Data in metric tons of thorium oxide (ThO_2) content, unless noted)

1. Domestic Production and Use: Thorium is a byproduct of processing monazite, an ore mineral of the lanthanides and yttrium. Domestic monazite was recovered as a byproduct of mining heavy minerals sands for titanium and zirconium minerals. Thorium-bearing monazite was mined in the United States by one company in Florida for its rare-earth content. Thorium products used and produced by the domestic industry came from imports and industry stocks. A separation plant in Texas produced thorium nitrate from imported concentrates. Thorium-containing residues and compounds, resulting from the processing of monazite and its concentrates for rare earths, was stored by processors in Tennessee and Texas. About 18 companies processed or fabricated thorium, into various forms, including nuclear fuel. Thorium was used as a metal, oxide, nitrate, and chloride. Nonenergy uses were in incandescent lamp mantles, magnesium-thorium alloys, refractories, welding rods, and other uses. Thorium was also used as nuclear fuel in a commercial electric generating plant.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production, refinery 2/	-	-	-	NA	NA
Imports, metal, alloys and compounds e/3/	24	33	23	46	47
Exports, ores and concentrates e/	2	6	4	4	10
Shipments from Govt. stockpile excesses	3	3	-	-	-
Consumption, nonenergy applications e/	25	30	19	42	37
Price, yearend, dollars per kilogram, ThO_2:					
Nitrate, mantle-grade	8.40	9.50	10.60	10.60	10.10
Oxide, 99% grade	16.00	21.20	24.50	31.00	35.85
Stocks, industrial, yearend	Not available				
Employment, mine	None				
Net import reliance 4/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1980-83): France 80%, Netherlands 8%, Canada 4%, Malta 4%, Other 4%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore	601.45	Free	Free	Free
Nitrate and oxide	422.10 & 422.12	10.2% ad val.	7.8% ad val.	35.0% ad val.
Unwrought metal, waste and scrap	632.52	4.7% ad val.	4.2% ad val.	25.0% ad val.
Alloys	632.68	4.1% ad val.	3.0% ad val.	25.0% ad val.

6. Depletion Allowance: Monazite, 22% on thorium content and 14% on rare-earth and yttrium content (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status 11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Thorium nitrate 5/	130	1,547	11	-

e/ Estimated. NA Not available.
1/ See also Rare-Earth Metals and Yttrium.
2/ All domestically consumed thorium was derived from imported materials.
3/ Includes estimated ThO_2 in imported gas mantles, thorium nitrate, thorium oxide, and other thorium compounds and metal. Monazite, containing 350 to 550 tons of thorium oxide, has been imported annually but has not recently been used to produce thorium products.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ Thorium oxide equivalent.
6/ See page 180 for definitions.

Prepared by J. B. Hedrick, telephone (202) 634-1082.

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8. Events, Trends and Issues: From a 1978 base, demand for thorium in nonfuel applications is expected to increase at an average annual rate of about 7% through 1990, due primarily to the expected increased use of magnesium-thorium hardeners in the aerospace industry, certain thoria refractory applications, and new catalytic processes. The quantity of thorium consumed for nuclear energy has been small when compared with other fuels. It is estimated that in 1985 U.S. apparent consumption of thorium will be 40 tons (ThO_2 equivalent), which would be met entirely by imports and existing industry and Government stocks.

The chief environmental concern in mining thorium from monazite-bearing placers along beaches and rivers was the possible conflict with urban and recreational land uses. Land reclamation was practiced successfully at operations in the United States and Australia. Public concern and foreign and domestic regulations on handling radioactive thorium materials have limited its use.

9. World Refinery Production and Reserve Base:

	Refinery Production		Reserve Base 6/
	1983	1984	
United States	NA	NA	200,000
Australia	NA	NA	40,000
Brazil	NA	NA	75,000
Canada	NA	NA	240,000
India	NA	NA	360,000
Malaysia	NA	NA	10,000
Norway	NA	NA	150,000
Other Market Economy Countries	NA	NA	55,000
Centrally Planned Economies	NA	NA	35,000
World Total (rounded)	NA	NA	1,160,000

10. World Resources: Large deposits of thorium occur in the United States in beach and stream placers, veins, and carbonatites. In these deposits there are thorium resources of more than 500,000 tons ThO_2. Disseminated deposits in various other alkaline igneous rocks contain additional resources of more than 2 million tons ThO_2. Large thorium resources are also found in Canada, India, Greenland, Brazil, the Republic of South Africa, and Australia.

11. Substitutes: No satisfactory alternate materials are suitable for major nonenergy uses of thorium, although research to develop non-radioactive substitutes was reported.

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TIN

(Data in metric tons of tin content, unless noted)

1. Domestic Production and Use: In 1984 small quantities of tin concentrates were produced from placer deposits in Alaska. The only U.S. tin smelter, at Texas City, TX, produced about 4,000 tons of tin from imported and domestic tin concentrates, residues, and other secondary tin-bearing materials. About one-fourth of the tin consumed in the United States was derived from secondary material at 5 detinning plants and 196 secondary nonferrous metal processing plants located principally in the East. Twenty-five firms consumed about 60% of the primary tin. The major uses were in cans and containers, 21%; electrical, 18%; construction, 14%; transportation, 14%; and other, 33%. The estimated value of consumption in 1984 was $600 million based on the New York composite price.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
			Negligible		
Production: Mine					
Smelter e/	3,000	2,000	3,500	2,500	4,000
Secondary (old scrap)	11,665	10,370	9,582	10,766	11,000
Imports for consumption: Metal	45,982	45,874	27,939	34,048	39,000
Ore	840	232	1,961	969	3,500
Exports: Ingots, pigs, and bars 1/	595	2,361	5,769	1,340	1,300
Shipments from Govt. stockpile excesses	25	5,920	4,172	2,865	2,245
Consumption, reported: Primary	44,342	40,229	36,194	34,301	38,000
Secondary	12,020	14,144	13,276	11,246	12,000
Consumption, apparent	54,508	54,457	40,258	49,231	51,800
Price: Average, cents per pound					
New York market	773	648	587	601	630
New York composite	846	733	654	655	574
London	762	650	581	589	561
Penang	746	638	587	591	570
Stocks: Consumer and dealer, yearend	12,101	11,131	10,251	9,859	9,000
Employment: Mine and primary smelter e/	400	300	250	200	200
Net import reliance 2/ as a percent of apparent consumption	79	77	68	73	79

3. Recycling: About 15,000 tons of tin, including tin alloys, was recycled in 1984. About 11,000 tons was from old scrap and 4,000 from new scrap.

4. Import Sources (1980-83): Thailand 30%, Malaysia 23%, Indonesia 16%, Bolivia 15%, Other 16%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	601.48	Free	Free	Free
Metal	622.02	Free	Free	Free
Waste and scrap	622.10	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Pig tin	42,674	188,320	19,484	2,297

e/ Estimated.
1/ Exports (excluding reexports).
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions. Reserve base data revised to include new data developed by the Division of Minerals Availability, U.S. Bureau of Mines.
4/ Excluding U.S. production.

Prepared by J. F. Carlin, Jr., telephone number (202) 634-1073.

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8. Events, Trends, and Issues: The reported consumption of primary tin increased about 11% from the 1983 level. From a 1983 base, demand for tin is expected to increase at an average annual rate of about 1% through 1990. It is estimated that in 1985 U.S. apparent consumption of tin will be 54,000 tons.

Tin prices did not fluctuate appreciably throughout 1984. There continued to be an estimated 80,000 ton worldwide excess of supply relative to demand, as demand increased slowly throughout the year.

The General Services Administration (GSA) continued its daily fixed-price sales of Government stockpile tin throughout the year, despite objection by producer countries in the International Tin Council (ITC). A memorandum of understanding between the United States and the Association of Southeast Asian Nations signed in December 1983, continued in effect throughout 1984, limiting GSA tin disposals to 6,000 tons during the period January 1, 1983, through December 31, 1984. Through November 30, 2,297 tons was sold. In April, GSA entered an agreement for the duration of 1984 with two metal processing firms to upgrade certain ores to ferroalloys. To pay for the processing, GSA awarded these firms about 1,930 tons of stockpile tin through November 1984. At yearend, GSA decided to continue the upgrading program into 1985. The United States is not a member of the ITC. Throughout the year the ITC continued imposition of export controls on member producer countries in an attempt to balance world tin supply and demand.

Tin was mined and smelted in such small quantities in the United States that environmental effects were almost nonexistent. In secondary detinning operations, tin-containing muds are generated as waste material. Waste water from the rinsing of detinned steel may contain small amounts of caustic, sodium nitrate and tin. Drosses and dusts from industrial centers eventually become sources of secondary tin.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	Negligible	Negligible	40,000
Australia	9,700	9,000	180,000
Bolivia	24,400	25,000	140,000
Brazil	12,000	14,000	70,000
Burma	1,600	1,600	10,000
Indonesia	27,000	26,000	680,000
Malaysia	42,000	40,000	1,110,000
Nigeria	1,000	1,200	20,000
Thailand	20,000	20,000	270,000
United Kingdom	4,100	4,000	90,000
Zaire	3,200	3,000	20,000
Other Market Economy Countries	11,200	10,000	260,000
China	15,000	16,000	80,000
U.S.S.R.	37,000	35,000	80,000
Other Centrally Planned Economies	4,000	4,000	30,000
World Total (May be rounded)	4/212,000	4/209,000	3,000,000

10. World Resources: U.S. tin resources, located primarily in Alaska, are insignificant when compared with those of the rest of the world. World resources are located principally in southeastern Asia, Australia, Bolivia, Brazil, China, and the U.S.S.R. Sufficient resources are available to sustain present production rates well into the next century.

11. Substitutes: Aluminum, glass, paper, plastic, or tin-free steel substitute for tin in cans and containers; epoxy resins for solder; aluminum alloys, copper-base alloys, or plastics from bronze; and lead-base bearing alloys or plastics for tin-containing bearing metals.

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TITANIUM AND TITANIUM DIOXIDE 1/
(Data in short tons, unless noted)

1. Domestic Production and Use: Sponge metal was produced by four firms, with production in Nevada, Ohio, Oregon, and Washington. Ingot was made by three sponge makers and by eight other firms located in eight States. Twenty-three companies produced titanium mill products or castings, mainly in the east-central region. In 1984, about 60% of the titanium metal was used in jet engines, airframes, and space and missile applications, about 20% was used in the chemical processing industry, power generation, and in marine and ordnance applications, and 20% in steel and other alloys. The value of sponge metal consumed in 1984 was about $180 million.

   Titanium dioxide (TiO_2) pigment was produced by 6 companies at 13 plants in nine States. In 1984, uses of TiO_2 were in paints, varnishes, and lacquers, 50%; paper, 26%; plastics, 13%; rubber, 2%; ceramics, 1%; and other 8%. The value of TiO_2 consumed in 1984 was about $1 billion.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Metal:					
Production	2/22,500	2/26,400	2/15,600	13,966	23,000
Imports for consumption, sponge	4,777	6,490	1,354	1,199	2,800
Exports, mainly scrap	8,880	9,644	8,096	7,830	7,300
Shipments from Govt. stockpile excesses			N o n e		
Consumption of sponge metal, reported	26,943	e/31,599	e/17,328	e/16,072	24,000
Price: Sponge, list, dollars per pound, yearend	7.02	7.65	5.55	5.55	5.55
Stocks: Sponge, industry, yearend	2,381	e/3,720	e/3,350	e/3,136	3,500
Employment: Reduction plants	2,000	2,200	1,500	1,500	1,800
Net import reliance 3/ sponge only as a percent of apparent consumption	W	W	W	9	9
Titanium Dioxide:					
Production	727,245	761,190	657,362	757,341	790,000
Imports for consumption	97,590	124,906	138,922	174,857	210,000
Exports	42,126	61,104	72,823	91,702	105,000
Consumption, apparent	753,480	806,040	738,717	849,964	904,000
Price: Rutile, list, dollars per pound, yearend	0.63	0.75	0.75	0.75	0.75
Stocks: Producer, yearend	83,237	102,189	86,953	77,465	68,000
Employment	4,600	4,600	4,400	4,200	4,400
Net import reliance 3/ as a percent of apparent consumption	3	6	11	11	12

3. Recycling: New scrap metal recycled was 15,000 tons in 1984. In addition, estimated use of scrap and ferrotitanium by the steel industry was 3,000 tons; by the aluminum industry, 600 tons; and in miscellaneous alloying uses, 300 tons. Old scrap reclaimed was about 100 to 400 tons. There was no known recycling of TiO_2.

4. Import Sources (1980-84): Sponge metal: Japan 85%, China 11%, U.S.S.R. 4%.
   Titanium dioxide pigment: Federal Republic of Germany 26%, France 16%, Canada 14%, Spain 12%, Other 32%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Waste and scrap metal	629.12	9.9% ad val.	7.2% ad val.	25.0% ad val.
Unwrought metal	629.14	16.0% ad val.	15.0% ad val.	25.0% ad val.
Wrought metal	629.20	16.0% ad val.	15.0% ad val.	45.0% ad val.
Titanium dioxide	473.70	6.4% ad val.	6.0% ad val.	30.0% ad val.

6. Depletion Allowance: Not applicable.

e/ Estimated.
1/ See also Ilmenite and Rutile.
2/ Calculated sponge metal production = sponge consumption - sponge imports + sponge exports and adjustments for Government and industry stock changes.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.

Prepared by L. E. Lynd, telephone number (202) 634-1075.

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7. Government Stockpile: Nearly all of the 4,500 tons of titanium sponge purchased for the stockpile by the General Services Administration (GSA) under contracts awarded in October 1983 was delivered in 1984, but was not yet included in the GSA stockpile inventory total shown below. With these acquisitions the total inventory will be 25,965 tons. The stockpile also contains an additional 10,866 tons of nonstockpile-grade sponge metal.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Stockpile grade	195,000	21,465	-	-

In an antidumping investigation, the International Trade Commission determined that imports for the stockpile from three Japanese sponge producers had caused material injury to the U.S. titanium industry. The Department of Commerce assessed antidumping duties averaging 28% against future imports from these firms.

8. Events, Trends, and Issues: Domestic titanium sponge production increased substantially in 1984, and was about 85% of capacity at yearend. A recovery in demand resulted mainly from increased orders for commercial and military aircraft, particularly for the B-1B bomber.

A major U.S. TiO_2 pigment producer purchased TiO_2 production facilities in the United Kingdom and Australia from a British firm. A former U.S. TiO_2 producer agreed to purchase TiO_2 pigment-production facilities in Savannah, GA. Sales of titanium sponge metal reportedly were mostly in the range of $3.75 to $4.50 per pound. Sales prices of TiO_2 pigment increased to about 7% below list.

It is estimated that in 1985 U.S. production of titanium sponge will be 25,000 tons, apparent consumption of sponge will be 28,000 tons, production of TiO_2 pigment will be 820,000 tons, and apparent consumption of pigment will be 920,000 tons.

From a 1984 base, demand for titanium sponge is expected to increase at an average annual rate of about 5% through 1990. From a 1981 base, demand for TiO_2 is expected to increase at an average annual rate of about 2% through 1990.

Titanium dioxide pigment plant effluents consist mainly of sulfuric acid, ferrous sulfate, and ferric chloride. Disposal methods include neutralization, deep-well disposal, and barging out to sea.

9. Sponge Metal Production and Sponge and Pigment Capacity:

	Sponge Production 1983	Sponge Production 1984 e/	Capacity 1984 Sponge	Capacity 1984 Pigment
United States 2/	13,966	23,000	33,500	874,000
Finland	-	-	-	88,000
France	-	-	-	182,000
Germany, Federal Republic of	-	-	-	353,000
Japan	11,600	18,000	37,500	250,000
United Kingdom	2,000	3,000	5,500	250,000
Other Market Economy Countries e/	-	-	-	589,000
China	2,000	2,000	3,000	22,000
U.S.S.R.	45,000	46,000	52,000	137,000
Other Centrally Planned Economies	-	-	-	84,000
World Total (May be rounded)	74,000	92,000	131,500	2,829,000

10. World Resources: The source of titanium for domestic sponge production was rutile. For pigment production the sources were ilmenite, slag, and rutile. The U.S.S.R. reportedly used a high-grade titaniferous slag for sponge metal production.

11. Sustitutes: For aircraft and space use there is essentially no substitute for titanium. For industrial uses high-nickel steel, zirconium, and to a limited extent the superalloy metals may be substituted. There is no cost-effective substitute for TiO_2 pigment.

January 1985

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TUNGSTEN

(Data in metric tons of tungsten content, unless noted)

1. Domestic Production and Use: In 1984, approximately 95% of the domestic tungsten concentrate production, valued at an estimated $11 million, came from three mines in California and Colorado. Two of these mining operations recovered metals other than tungsten. Estimated production, as measured by domestic mine shipments, increased 27% during the year. End uses of tungsten were: Metalworking, mining, and construction machinery and equipment, 75%; electrical machinery and equipment, 9%; lamps and lighting, 7%; transportation, 5%; and other, 4%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production, mine shipments	2,738	3,545	1,575	1,016	1,300
Imports for consumption, concentrate	5,158	5,331	3,528	2,861	5,900
Exports, concentrate	920	79	305	1	200
Shipments from Govt. stockpile excesses, concentrate	1,703	958	344	259	1,400
Consumption: Reported, concentrate	9,268	9,839	4,506	5,181	8,800
Apparent, concentrate, scrap, metal	9,939	10,317	6,050	6,478	10,900
Price, concentrate, dollars/mtu WO_3 1/, average:					
U.S. market	144	144	106	85	88
European market	143	142	107	81	85
Stocks: Producer and consumer, yearend, concentrate	649	779	1,819	1,132	1,500
Employment: Mine and mill	880	907	475	300	300
Net import reliance 2/ as a percent of apparent consumption	53	50	42	52	71

3. Recycling: During 1984, the quantity of purchased scrap represented about 1,900 tons.

4. Import Sources (1980-83): Canada 19%, China 17%, Bolivia 14%, Other 50%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	601.54	17¢/lb. W cont.	17¢/lb. W cont.	50¢/lb. W cont.
Ferrotungsten	606.48	6.9% ad val.	5.6% ad val.	35% ad val.
Unwrought lumps, grains, and powders	629.28	12.1% ad val.	10.5% ad val.	58% ad val.
Ammonium tungstate	417.40	10.8% ad val.	10% ad val.	49.5% ad val.
Tungsten carbide	422.40	11.5% ad val.	10.5% ad val.	55.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: The General Services Administration continued to offer excess tungsten concentrate for sale at a rate of 2,722 tons per year. In addition to quantities shown below, the stockpile contains the following nonstockpile-grade materials (in tons): Ore and concentrate, 12,493; metal powder, 150; ferrotungsten, 537; and carbide powder, 51; during the first 9 months of 1984, all ore and concentrate was authorized for disposal, but new legislation authorized only 1,088 tons for disposal during the last 3 months. The total quantity of nonstockpile-grade material disposals during the first 11 months was 852 tons.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Ore and concentrate	25,152	24,718	72	602
Metal powder	726	711	-	-
Ferrotungsten	-	381	-	-
Carbide powder	907	871	-	-

e/ Estimated.
1/ A metric ton unit (mtu) of tungsten trioxide (WO_3) contains 7.93 kilograms of tungsten.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.

Prepared by P. T. Stafford, telephone number (202) 634-1029.

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8. Events, Trends, and Issues: Estimated world production and consumption of tungsten in concentrate increased 11% and 20%, respectively, in 1984 compared with that of 1983, as demand for tungsten in cemented carbides, mill products, and steel increased substantially. In the United States, consumption increased by an estimated 70%. The average U.S. monthly price of tungsten concentrate was $75/mtu WO_3 in January, $90 in July, and $83 in November.

It is estimated that in 1985 domestic mine production of tungsten will be 2,000 tons and U.S. apparent consumption will be 11,000 tons. From a 1983 base, U.S. demand for tungsten is expected to increase at an average annual rate of about 15.9% through 1990. Two of the five major U.S. tungsten mines were temporarily closed at the end of November 1984 because of low prices. Mine capacity utilization was approximately 26%, which resulted in the net import reliance increasing from 52% in 1983 to 71% in 1984.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States (mine shipments)	1,016	1,300	290,000
Australia	2,060	2,000	143,000
Austria	1,117	1,400	18,000
Bolivia	2,400	2,600	70,000
Brazil	1,200	1,000	20,000
Burma	930	1,000	15,000
Canada	327	3,200	670,000
France	700	700	20,000
Korea, Republic of	2,293	2,400	58,000
Portugal	1,360	1,400	40,000
Thailand	562	800	31,000
Other Market Economy Countries	2,803	3,200	250,000
China	12,500	12,500	1,230,000
U.S.S.R.	9,100	9,100	490,000
Other Centrally Planned Economies	550	600	115,000
World Total	38,918	43,200	3,460,000

10. World Resources: More than 90% of the world's estimated tungsten resources are located outside the United States, with about 50% located in China. Other areas with significant resource potential are in Australia, Austria, Burma, Canada, Malaysia, Mexico, North Korea, Portugal, Republic of Korea, southern Africa, South America, Thailand, Turkey, Tuvalu, and the U.S.S.R.

11. Substitutes: Coatings, such as aluminum oxide, titanium carbide, and titanium nitride, have improved the cutting and wear resistance of cemented tungsten carbide tool inserts. The use of coatings is expected to increase appreciably during the next few years. This extended wear capability of the inserts decreases the rate of replacement and, hence, the growth of tungsten consumption. Titanium and other carbides and ceramics can be substituted economically for tungsten in some wear-resisting applications. Molybdenum tool steels and tungsten tool steels can be substituted for each other.

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VANADIUM

(Data in thousand pounds vanadium content, unless noted)

1. Domestic Production and Use: Three firms produced vanadium oxides in 1984 from domestic materials that included Colorado Plateau uranium-vanadium ores and Idaho ferrophosphorus slags. Three other firms produced oxides and/or ferrovanadium from petroleum residues, utility ash, spent catalysts, and imported iron slags. Mill production was valued at an estimated $37 million. The chief use of vanadium was as an alloying agent for iron and steel. It was also important in the production of titanium alloys, and as a catalyst for production of sulfuric acid. About 160 plants throughout the United States reported consumption in 1984. Major end use distribution: Transportation, 41%; machinery, 25%; construction, 20%; and other, 14%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production:					
Mine, recoverable basis	9,612	10,252	8,196	4,342	5,600
Mill, recovered basis 1/	11,012	12,736	9,734	4,866	6,400
Petroleum residues, recovered basis	3,040	3,800	3,026	1,786	3,200
Imports for consumption:					
Ores, slags, residues	3,572	4,870	2,224	115	260
Vanadium pentoxide, anhydride	1,711	669	238	754	380
Ferrovanadium	525	1,968	1,339	1,362	2,400
Exports:					
Ores	92	111	114	117	30
Vanadium pentoxide, anhydride	811	388	1,772	2,967	4,800
Other compounds	228	72	434	114	460
Ferrovanadium	1,123	608	457	1,085	690
Shipments from Government stockpile excesses	-	-	-	-	2/(136)
Consumption: Reported	12,278	13,726	6,992	6,554	9,500
Apparent 3/	17,042	19,168	12,812	6,602	11,000
Price, average, dollars per pound V_2O_5	3.54	3.52	3.50	3.50	3.50
Stocks: Producer and consumer, yearend	8,538	9,426	11,096	9,674	9,400
Employment: Mine and mill	1,800	1,700	1,300	800	800
Net import reliance 4/ as a percent of apparent consumption	35	34	24	26	41

3. Recycling: Relatively small quantities of spent catalysts containing vanadium were reprocessed. Some tool steel scrap was recycled primarily for its vanadium content. Vanadium was also recycled as a minor component of scrap iron and steel alloys, which were used principally for their iron content.

4. Import Sources (1980-83): Republic of South Africa 44%, Canada 13%, Finland 10%, Other 33%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	601.60	Free	Free	Free
Vanadium-bearing materials (slags and residues)	603.65	Free	Free	Free
Ferrovanadium	606.50	4.6% ad val.	4.2% ad val.	25% ad val.
Metal, unwrought, and waste & scrap	632.58	4.0% ad val.	3.7% ad val.	25% ad val.
Ammonium vanadate	417.42	12.4% ad val.	11.2% ad val.	40% ad val.
Potassium vanadate	420.34	12.4% ad val.	11.2% ad val.	40% ad val.
Vanadium carbide	422.58	4.7% ad val.	4.2% ad val.	25% ad val.
Vanadium pentoxide, anhydride	422.60	16.0% ad val.	16.0% ad val.	40% ad val.
Vanadium compounds, other	422.62	16.0% ad val.	16.0% ad val.	40% ad val.

e/ Estimated.
1/ Produced from domestic materials.
2/ Data in parentheses denote stockpile acquisitions.
3/ Includes processing losses from low-grade imports.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 180 for definitions.
6/ Includes data for Bophuthatswana.

Prepared by P. H. Kuck, telephone number (202) 634-1021.

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6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: On June 4, a multinational producer was awarded a contract at $2.95 per pound V_2O_5 to supply the General Services Administration with 160,000 pounds of vanadium contained in vanadium pentoxide meeting Grade A purchase specifications.

Stockpile Status--11-30-84

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months	Purchases, 11 Months
Vanadium pentoxide	15,400	1,218	-	-	136
Ferrovanadium	2,000	-	-	-	-

8. Events, Trends, and Issues: The U.S. vanadium industry underwent a major restructuring between 1982 and 1985 in order to better compete in Western World markets against materials derived from Chinese and South African magnetite ores. The restructuring was triggered by (1) the sharp decline in ferrovanadium consumption by domestic steel producers from 1982 through 1984, and (2) continuing depressed prices for coproduct uranium. In the future, consumption of vanadium should grow with increased demand for high performance materials and especially for high-strength low-alloy steels. It is estimated that in 1985 domestic mine production will be 6 million pounds on a recoverable basis, and apparent consumption will be 11 million pounds. From a 1981 base, demand for vanadium is expected to increase at an average annual rate of 3% through 1990.

Five of the nine U.S. facilities that produced vanadium oxides in 1981, the last year of normal production, were on standby during the first half of 1984. The weak and slow recovery of the steel industry during the year gave little encouragement to the remaining hard-pressed producers and converters of vanadium oxides. In Canada, large-scale equipment was under development for extracting vanadium from fly ash generated by commercial oil sands plants. Overseas, a major South African producer of vanadium ores and slags completed construction of its second vanadium-bearing pig iron plant, but deferred commissioning because of weak demand for steel in international markets. Vanadiferous slag production facilities were also under construction in New Zealand.

One multinational producer began marketing a new vanadium oxide product in May. The new product, designed primarily for addition to tool steel, is expected to compete against more expensive, imported ferrovanadium.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 5/
	1983	1984 4/	
United States	4,342	5,600	4,800,000
Australia	-	-	540,000
Finland	7,032	7,100	200,000
South Africa, Republic of 6/	17,800	19,000	17,200,000
Other Market Economy Countries	-	-	1,200,000
China	10,000	11,000	3,600,000
U.S.S.R.	21,000	21,000	9,000,000
World Total (rounded)	60,000	64,000	36,500,000

10. World Resources: World resources of vanadium exceed 140 billion pounds. Vanadium occurs in deposits of titaniferous magnetite, phosphate rock, and uraniferous sandstones and siltstones, where it constitutes less than 2% of the host rock. Significant amounts are also present in bauxite and carboniferous materials such as crude oil, coal, oil shale, and tar sands. Because vanadium is generally recovered as a byproduct or coproduct, demonstrated world resources of the element are not fully indicative of available supplies. While domestic resources are adequate to supply current domestic needs, a substantial part of U.S. demand is currently met by foreign material because of price advantages.

11. Substitutes: Steels containing various combinations of other alloying metals can be substituted for steels containing vanadium. Among the various metals that are interchangeable to some degree with vanadium are columbium, molybdenum, manganese, titanium, and tungsten. There is currently no acceptable substitute for vanadium in titanium alloys. Metallic platinum can replace vanadium compounds as a catalyst in some chemical processes.

January 1985

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VERMICULITE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Value of production from 3 companies was $33 million in 1984. One company, operating an open pit in Montana and several pits in South Carolina, continued as the principal producer of vermiculite in 1984. Most of the vermiculite concentrate was shipped to 43 exfoliating plants in 29 States. The major uses for exfoliated vermiculite were agriculture, 25%; insulation, 28%; plaster and cement premixes, 24%; and lightweight concrete aggregate, 21%.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine 1/	337	320	316	282	320
Imports for consumption e/	26	27	21	24	25
Exports	30	31	22	19	20
Consumption, apparent: Concentrate	333	316	315	287	325
Consumption: Exfoliated	281	274	235	224	260
Price: Average value, dollars per ton, f.o.b. mine	69.73	81.88	90.19	96.45	102.00
Stocks, producer, yearend		Not available			
Employment: Mine and mill e/	330	330	300	300	300
Net import reliance 2/ as a percent of apparent consumption	E	E	E	2	2

3. Recycling: Insignificant.

4. Import Sources (1980-83): Republic of South Africa, 94%, Brazil, 6%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Crude or processed	523.81	Free	Free	Free

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net exports. NA Not available.
1/ Concentrate sold or used by producers.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 180 for definitions.
4/ Excluding Centrally Planned Economies.

Prepared by A. C. Meisinger, telephone number (202) 634-1184.

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8. Events, Trends, and Issues: From a 1983 base, demand for vermiculite is expected to increase at an average annual rate of about 2% through 1990. Transportation costs from the mine to exfoliation plants near the point of end use continued to limit the size of the market as well as vermiculite's competitive position with respect to other mineral commodities. The number of operating quarries is small, and the industry does not have any severe environmental problems. It is estimated that in 1985 domestic mine production of vermiculite concentrate and U.S. apparent consumption will each be about 340,000 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1983	1984 e/	
United States	282	320	100,000
South Africa, Republic of	169	200	80,000
Other Market Economy Countries	44	50	20,000
Centrally Planned Economies	NA	NA	NA
World Total 4/	495	570	200,000

10. World Resources: Marginal reserves of vermiculite, which occur in North Carolina, Texas, Wyoming, Colorado and Nevada, are estimated to be 2 to 3 million tons. Resources in other Market Economy Countries and in Centrally Planned Economies usually include material that has exfoliation characteristics considered to be inferior to U.S. and South African vermiculite. Total world resources are estimated to be up to three times the reserves.

11. Substitutes: Expanded perlite is a substitute for vermiculite in lightweight concrete and plaster. Other more dense but less costly substitutes in these applications are expanded clay, shale, slate or slag. Alternate materials for loosefill fireproofing insulation include fiberglass, perlite, and slag wool. In agriculture, substitutes include peat, perlite, sawdust, bark and other plant materials, and synthetic soil conditioners.

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YTTRIUM 1/

(Data in metric tons of yttrium oxide (Y_2O_3) content, unless noted)

1. Domestic Production and Use: Yttrium is a constituent in the domestically mined rare-earth minerals, bastnasite and monazite, but was not separated from these minerals during processing. Purified yttrium produced in the United States was derived from imported ores and concentrates. Three companies processed concentrates in 1984 to produce finished and intermediate yttrium products at plants located in Arizona, Colorado, and Texas. Separated yttrium metal and compounds were consumed by 5 television phosphor producers, 3 lamp phosphor producers, 7 synthetic garnet producers, and at least 11 other companies making various products. These companies were located throughout the United States. Yttrium, which is chemically similar to the rare-earth elements and not always separated from them, is a functioning constituent of some rare-earth alloys and compounds.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production, mine and refinery	W	W	W	W	W
Imports for consumption:					
Monazite	56	82	79	44	66
Xenotime and yttrium concentrate 2/3/	W	W	W	W	W
Exports, ore and concentrate e/	5	6	4	3	6
Consumption, apparent e/4/	135	153	124	53	70
Stocks, processor, yearend	W	W	W	W	W
Employment	Not available				
Net import reliance 5/ as a percent of apparent consumption	100	100	100	100	100

Prices, dollars, yearend 1984: Monazite concentrates, 342-375 per ton or 33.45-36.75 per kilogram contained yttrium; yttrium concentrates (60% Y_2O_3), 51-57 per kilogram; xenotime 22-29 per kilogram of contained yttrium oxide; yttrium oxide, 94-800 per kilogram depending on purity; yttrium metal, 430 per kilogram.

3. Recycling: None.

4. Import Sources (1980-83): Monazite--Australia 95%, Malaysia 5%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrates	601.12 & 601.45	Free	Free	Free
Other metal-bearing materials, etc. (yttrium concentrate)	603.70	5.6% ad val.	5.0% ad val.	30.0% ad val.
Metal	632.38	4.0% ad val.	3.7% ad val.	25.0% ad val.
Alloys	632.78	36¢/lb	32¢/lb	$2/lb

6. Depletion Allowance: Monazite: 22% on thorium content and 14% on yttrium and rare earth content (Domestic), 14% (Foreign). Xenotime: 14% (Domestic and Foreign).

7. Government Stockpile:

Stockpile Status--11-30-84

Material	Coal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Yttrium Oxide	-	108 kg	108 kg	-

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ See also Rare-Earth Metals and Thorium.
2/ Xenotime, an yttrium-rare earth mineral, is chemically treated to produce yttrium concentrate.
3/ Reported by processors.
4/ All imported or refined from imported ore or concentrate.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ Includes yttrium contained in rare-earth ores.
7/ See page 180 for definitions.

Prepared by J. B. Hedrick, telephone number (202) 634-1082.

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8. Events, Trends, and Issues: Yttrium was in short supply in 1984 as a result of increased demand for its use in television and lighting phosphors, and in ceramic applications such as oxygen sensors and refractory stabilizers. It is estimated that in 1985 domestic mine production of yttrium contained in monazite will be essentially the same as in 1984 and U.S. apparent consumption will be 160 tons. From a 1983 base, demand for yttrium oxide is expected to increase at an average annual rate of about 3% through 1990.

Exploration and feasibility studies continued at a large yttrium-beryllium-zirconium deposit in northeastern Quebec, Canada. If developed, this deposit could provide a substantial part of the world's supply of yttrium.

Domestic yttrium oxide was processed by solvent extraction and ion exchange processes. Lowering the cost of production and an improved understanding of yttrium's properties could lead to new applications and increased consumption.

The impact of the production and use of yttrium products on the environment was generally minimal, but certain yttrium placer resources, principally monazite and xenotime, were excluded from production because of environmental considerations.

9. World Mine Production and Reserve Base:

	Mine Production 6/ e/		Reserve Base 7/
	1983	1984	
United States	W	W	4,100
Australia	160	160	5,800
Brazil	22	20	500
Canada	-	-	28,800
India	44	40	56,000
Malaysia	4	5	NA
Thailand	2	2	NA
Other Market Economy Countries	NA	NA	NA
Centrally Planned Economies	NA	NA	NA
World Total	NA	NA	NA

10. World Resources: Large resources of yttrium in monazite and xenotime are available worldwide in placer and beach-sand deposits. Additional large subeconomic resources of yttrium occur in other monazite-bearing deposits, apatite-magnetite rocks, sedimentary phosphate deposits, deposits of columbium-tantalum minerals, and certain uranium ores, especially those of the Blind River district, Canada. From knowledge of the geologic occurrence of yttrium, it is probable that the world's resources are very large relative to expected demand.

11. Substitutes: Substitutes are available for many applications of yttrium, but generally are much less effective. In most uses, especially in phosphors and ceramics, yttrium is not subject to substitution by other elements.

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ZINC

(Data in thousand metric tons of zinc content, unless noted)

1. Domestic Production and Use: The value of mine production in 1984, based on the price of metal, was $280 million. The 25 leading mines accounted for 98% of mine output, with the leading five producing 54%. About 85% of the total mine output was produced in Tennessee, New York, and Missouri. Five primary and ten secondary smelters produced slab zinc. About 60% of the slab consumption was by approximately 220 firms in Illinois, Indiana, New York, Ohio, and Pennsylvania. Construction materials accounted for about 45% of consumption; transportation, 25%; machinery, 11%; electrical, 9%; and other, 10%. Of the total slab zinc consumed, galvanizing accounted for 45%; zinc-base alloys, 27%; brass and bronze, 16%; and other, 12%. About 200,000 tons of zinc in compounds and dusts were consumed mainly by the chemical, agricultural, rubber, and paint industries. Major coproducts of zinc were lead, cadmium, and silver.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Mine	317	312	300	275	265
Primary slab zinc	340	397	228	236	260
Secondary redistilled slab zinc	29	50	74	69	70
Imports for consumption: Ore and concentrates	182	246	50	63	55
Slab zinc	410	612	456	618	630
Exports: Zinc metal, including scrap	30	30	17	21	35
Ore and concentrates	54	54	77	60	30
Shipments from Govt. stockpile excesses			None		
Consumption: Reported, slab zinc	811	841	709	806	890
Apparent, all forms	1,004	1,052	904	1,005	1,030
Price: Average, cents per pound					
U.S. High Grade metal	37.4	44.6	38.5	41.4	46.0
London, Prime Western equivalent	34.5	38.5	33.7	37.8	41.5
Stocks, yearend: Producer and consumer	92	127	112	113	105
Merchant	34	69	47	35	33
Employment: Mine and mill 1/	5,500	4,200	3,200	2,900	2,900
Smelter e/	3,000	2,100	1,600	1,600	2,000
Net import reliance 2/ as a percent of apparent consumption	60	64	58	65	67

3. Recycling: In 1984, an estimated 80,000 tons of zinc was recovered from old scrap; an additional 260,000 tons of zinc was recovered from new scrap. About 70,000 tons of slab zinc or 8% of slab zinc consumption was produced from secondary material. In addition, about 50,000 tons of zinc dust and 40,000 tons of zinc oxide was produced from zinc scrap.

4. Import Sources (1980-83): Ore, concentrates--Canada 59%, Peru 15%, Mexico 11%, Other 15%.
Metal--Canada 54%, Peru 7%, Mexico 6%, Australia 5%, Other 28%.

5. Tariff:

	Number:	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Ore and concentrate	602.20	0.39¢/lb 3/	0.3¢/lb 3/	1.7¢/lb
Unwrought metal	626.02	1.6% ad val.	1.5% ad val.	1.75¢/lb
Alloys	626.04	19.0% ad val.	19.0% ad val.	45.0% ad val.
Waste and scrap	626.10	2.9% ad val. 3/	2.1% ad val. 3/	11.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Material	Goal	Stockpile Status--11-30-84 Total Inventory	Excess to Goal Authorized For Disposal	Sales, 11 Months
Zinc	1,293	343	-	-

e/ Estimated.
1/ Includes all zinc and/or lead-zinc producing units.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Duty suspended until December 1989, as provided by P.L. 98-573.
4/ See page 180 for definitions.

Prepared by J. H. Jolly, telephone number (202) 634-1063.

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6. Events, Trends, and Issues: Zinc consumption rose in 1984 owing to continued growth in the U.S. economy. Increased zinc usage over 1983 reflected higher automobile and major appliance production, increased capital investment in industrial plants and equipment, and increases in residential housing construction. In 1985, slower economic growth is expected to keep zinc consumption at about the 1984 level. From a 1981 base, domestic demand for zinc is expected to increase at an average annual rate of about 2.2% through 1990.

Mine production in 1984 fell to a 50-year low, largely owing to strikes at mines in Missouri and Tennessee. Losses in output due to the permanent closing of a zinc mine in Pennsylvania in late 1983 were offset for the most part by the reopening of two mines in Tennessee in 1984. It is estimated that in 1985 domestic mine production of zinc will rebound to about the 300,000-ton level assuming strike-free operations in Missouri and Tennessee and added production from two new lead-zinc mines being developed in Missouri. Reductions in labor costs continued as a means to trim operational costs.

Metal production was up about 8% in 1984, mainly due to the reopening of a zinc smelter in Texas. Output in 1985 is expected to increase marginally mainly due to improved smelter capacity utilization coupled with higher domestic zinc mine production. Although smelter output improved in 1984, imports of slab zinc were at record levels because of strong demand. Zinc metal imports are anticipated to remain at high levels in 1985.

High Grade Zinc prices responding especially to strong demand for Special High Grade metal, advanced from 49 cents per pound at the end of 1983 to 51 cents in mid-January 1984 and to 53 cents in March. Prices weakened in late May and fell to 45 cents per pound by mid-September. In the fourth quarter of 1984 discounting from the 45 cents-per-pound price was widespread. The average price for High Grade was about 48 cents in 1984.

Environmental concerns in the zinc industry are more associated with coproduct elements such as lead, cadmium, and sulfur, than with zinc. Waste rock, effluents, gases, and fume are controlled by modern technology. At some mines, the tailings and waste rock are sold as crushed rock and agricultural limestone. Proposed environmental legislation and renewal of Superfund could result in increased zinc prices and/or production costs, especially if Superfund includes a tax on zinc metal as proposed in several Congressional bills that did not pass in 1984.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1983	1984 e/	
United States	275	265	53,000
Australia	695	645	39,000
Canada	1,070	1,185	56,000
Mexico	257	280	8,000
Peru	553	565	12,000
Other Market Economy Countries	1,934	1,950	90,000
Centrally Planned Economies	1,462	1,460	32,000
World Total	6,246	6,350	290,000

10. World Resources: Identified zinc resources of the world are estimated at about 1.8 billion tons. Available data on sphalerite-bearing coals in mid-continent United States indicate a resource potential of many millions of tons of zinc metal that could possibly be recovered as a byproduct of coal mining with limited modification of existing technology. Preliminary evaluations suggest that some coals on other continents may have similar zinc resources.

11. Substitutes: Aluminum, plastics, and magnesium are the major substitutes for die casting uses. Plastic coatings, paints, electroplated cadmium, and aluminum-zinc coatings can replace zinc in limited areas for corrosion protection, and aluminum alloys can be used in place of brass. Aluminum, magnesium, titanium, and zirconium are significant competitors of zinc in chemicals and pigments.

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ZIRCONIUM 1/
(Data in short tons, unless noted)

1. Domestic Production and Use: Two companies, one with a plant in Oregon and another with a plant in Utah, produced primary zirconium sponge and coproduct hafnium sponge in 1984. These firms also converted zirconium sponge to ingot. Zircon, the only significant domestic ore mineral of zirconium and hafnium, was extracted in 1984 from sand deposits, as a coproduct of ilmenite and rutile, by two firms in Florida. The value of reported consumption of zircon in 1984 was about $18.5 million. Most zircon was used in the Eastern United States; 45% was used in foundry sands, 20% in refractories, 12% in ceramics, 6% in abrasives, and 17% in miscellaneous uses, including the manufacture of chemicals and production of zirconium metal and alloys for nuclear applications and for chemical processing equipment.

2. Salient Statistics--United States:

	1980	1981	1982	1983	1984 e/
Production: Zircon	W	W	W	W	W
Zirconium metal	W	W	W	W	W
Imports for consumption:					
Zircon	2/113,784	2/91,108	2/68,465	2/44,487	62,000
Zirconium metal	721	513	276	383	650
Exports: Zircon	7,727	11,630	11,012	13,222	6,000
Zirconium, alloys, and scrap	694	681	878	747	800
Consumption: reported, zircon 3/	140,000	150,000	93,000	100,000	130,000
apparent, zircon	W	W	W	W	W
Price: Zircon, domestic, dollars per ton, yearend	165	165	165	165	165
Stocks: Zircon, consumer and dealer, yearend 4/	69,473	50,310	48,575	36,495	70,000
Employment: Mine and mill	410	390	325	325	375
Metal plant	1,100	1,500	1,800	1,750	1,800
Net import reliance 5/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1980-83): Zirconium: France 70%, Japan 18%, Canada 9%, Other 3%.
Zircon: Australia 82%, Republic of South Africa 16%, Other 2%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/85	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/85
Zirconium oxide	422.80	4.0% ad val.	3.7% ad val.	25.0% ad val.
Other zirconium compounds	422.82	4.0% ad val.	3.7% ad val.	25.0% ad val.
Zirconium ore & concentrate	601.63	Free	Free	Free
Unwrought zirconium, waste and scrap	629.60	4.7% ad val.	4.2% ad val.	25.0% ad val.
Unwrought zirconium alloys	629.62	5.6% ad val.	4.9% ad val.	25.0% ad val.
Wrought zirconium	629.65	6.4% ad val.	5.5% ad val.	45.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Hafnium.
2/ Includes baddeleyite (zirconium oxide): 1980, 1,600 tons; 1981, 1,700 tons; 1982, 500 tons; 1983, 1,000 tons.
3/ Based on incomplete reported data.
4/ Excludes foundries.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 180 for definitions.
7/ Excluding U.S. production.

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8. Events, Trends, and Issues: The output of zircon by U.S. producers in 1984 increased over that of 1983 while the production of zirconium metal was about the same. Zircon imports, mostly from Australia, increased about 40% over 1983, while exports were about 55% lower than in 1983. It is estimated that in 1985 U.S. reported consumption of zircon will be 130,000 tons. The use of zircon in refractories, abrasives and chemicals is expected to grow, as is the use of zirconium metal in refractory and corrosion-resistant alloys, but the metal's use in nuclear reactors is expected to remain about the same. From a 1978 base, demand for zirconium, in metal and nonmetal forms, is expected to increase at an average annual rate of about 4% through 1990.

A U.S. company developed a process for making zirconium metal powders directly from metal sponge in 1984. Powder metal parts were expected to show cost advantages of 25% to 30%. Initial applications of powder metal parts were expected to be in corrosive environments in the chemical processing industry.

A South African company remodeled its plant for producing baddeleyite, the naturally occurring form of zirconia, to provide increased capacity and flexibility. A new plant was built to produce milled and chemically purified baddeleyite used in the ceramic colors industry. Modifications were also made to the plant producing zirconium sulfate tetrahydrate used in the chemical and leather tanning industries.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 6/
	1983	1984 e/	
United States	W	W	8,000,000
Australia	510,000	700,000	14,000,000
India	13,000	13,000	3,000,000
South Africa, Republic of e/	140,000	140,000	12,000,000
Other Market Economy Countries	14,000	14,000	5,000,000
China e/	16,500	16,500	1,000,000
U.S.S.R. e/	90,000	90,000	5,000,000
World Total (may be rounded)	7/784,000	7/974,000	48,000,000

10. World Resources: Resources of zircon in the United States include about 14 million tons associated with titanium resources in sand deposits, occurring mainly in the Atlantic and Gulf Coast States. Phosphate, and sand and gravel deposits may yield substantial amounts of zircon as a byproduct in the future. Identified world resources of zircon exceed 60 million tons.

11. Substitutes: Chromite and some aluminum silicate minerals may substitute for zircon in certain foundry applications.

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RESOURCE RESERVE DEFINITIONS
(From Geological Survey Circular 831, 1980.)

Principles of a Resource/Reserve Classification for Minerals

By the U.S. BUREAU OF MINES and the U.S. GEOLOGICAL SURVEY

INTRODUCTION

Through the years, geologists, mining engineers, and others operating in the minerals field have used various terms to describe and classify mineral resources, which as defined herein include energy materials. Some of these terms have gained wide use and acceptance, although they are not always used with precisely the same meaning.

Staff members of the U.S. Bureau of Mines and the U.S. Geological Survey collect information about the quantity and quality of all mineral resources, but from different perspectives and with different purposes. In 1976, a team of staff members from both agencies developed a common classification and nomenclature, which was published as U.S. Geological Survey Bulletin 1450-A – "Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey." Experience with this resource classification system showed that some changes were necessary in order to make it more workable in practice and more useful in long-term planning. Therefore, representatives of the U.S. Geological Survey and the U.S. Bureau of Mines collaborated to revise Bulletin 1450-A.

Long-term public and commercial planning must be based on the probability of discovering new deposits, on developing economic extraction processes for currently unworkable deposits, and on knowing which resources are immediately available. Thus, resources must be continuously reassessed in the light of new geologic knowledge, of progress in science and technology, and of shifts in economic and political conditions. To best serve these planning needs, known resources should be classified from two standpoints: (1) purely geologic or physical/chemical characteristics – such as grade, quality, tonnage, thickness, and depth – of the material in place: and (2) profitability analyses based on costs of extracting and marketing the material in a given economy at a given time. The former constitutes important objective scientific information of the resource and a relatively unchanging foundation upon which the latter more variable economic delineation can be based.

The revised classification system, designed generally for all mineral materials, is shown graphically in figures 1 and 2 (see page 5); its components and their usage are described in the text. The classification of mineral and energy resources is necessarily arbitrary, because definitional criteria do not always coincide with natural boundaries. The system can be used to report the status of mineral and energy fuel resources for the Nation or for specific areas.

RESOURCE/RESERVE DEFINITIONS

A dictionary definition of resource, "something in reserve or ready if needed," has been adapted for mineral and energy resources to comprise all materials, including those only surmised to exist, that have present or anticipated future value.

Resource. – A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

Original Resource. – The amount of a resource before production.

Identified Resources. – Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. *Identified resources* include economic, marginally economic, and subeconomic components. To reflect varying degrees of geologic certainty, these economic divisions can be subdivided into *measured*, *indicated*, and *inferred*.[1]

Demonstrated. – A term for the sum of *measured* plus *indicated*.

Measured. – Quantity is computed from dimensions revealed in outcrops, trenches, workings, or drill holes; grade and(or) quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

Indicated. – Quantity and grade and(or) quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

Inferred. – Estimates are based on an assumed continuity beyond measured and(or) indicated resources, for which there is geologic evidence. *Inferred resources* may or may not be supported by samples or measurements.

[1]The terms "proved," "probable," and "possible", which are commonly used by industry in economic evaluations of ore or mineral fuels in specific deposits or districts, have been loosely interchanged with the terms *measured*, *indicated*, and *inferred*. The former terms are not a part of this classification system.

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Reserve Base. – That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The *reserve base* is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The *reserve base* includes those resources that are currently economic (*reserves*), marginally economic (*marginal reserves*), and some of those that are currently subeconomic (*subeconomic resources*). The term "geologic reserve" has been applied by others generally to the *reserve-base* category, but it also may include the *inferred-reserve-base* category; it is not a part of this classification system.

Inferred Reserve Base. – The in-place part of an identified resource from which inferred reserves are estimated. Quantitative estimates are based largely on knowledge of the geologic character of a deposit and for which there may be no samples or measurements. The estimates are based on an assumed continuity beyond the reserve base, for which there is geologic evidence.

Reserves. – That part of the reserve base which could be economically extracted or produced at the time of determination. The term *reserves* need not signify that extraction facilities are in place and operative. *Reserves* include only recoverable materials; thus, terms such as "extractable reserves" and "recoverable reserves" are redundant and are not a part of this classification system.

Marginal Reserves. – That part of the reserve base which, at the time of determination, borders on being economically producible. Its essential characteristic is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors.

Economic. – This term implies that profitable extraction or production under defined investment assumptions has been established, analytically demonstrated, or assumed with reasonable certainty.

Subeconomic Resources. – The part of identified resources that does not meet the economic criteria of reserves and marginal reserves.

Undiscovered Resources. – Resources, the existence of which are only postulated, comprising deposits that are separate from identified resources. *Undiscovered resources* may be postulated in deposits of such grade and physical location as to render them economic, marginally economic, or subeconomic. To reflect varying degrees of geologic certainty, undiscovered resources may be divided into two parts:

Hypothetical Resources. – Undiscovered resources that are similar to known mineral bodies and that may be reasonably expected to exist in the same producing district or region under analogous geologic conditions. If exploration confirms their existence and reveals enough information about their quality, grade, and quantity, they will be reclassified as identified resources.

Speculative Resources. – Undiscovered resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential. If exploration confirms their existence and reveals enough information about their quantity, grade, and quality, they will be reclassified as identified resources.

Restricted Resources/Reserves. – That part of any resource/reserve category that is restricted from extraction by laws or regulations. For example, *restricted reserves* meet all the requirements of reserves except that they are restricted from extraction by laws or regulations.

GUIDELINES FOR CLASSIFICATION OF MINERAL RESOURCES

1. All naturally occurring metals, nonmetals, and fossil fuels in sufficient concentration can be classified in one or more of the categories.

2. Where the term *reserves* is used alone, without a modifying adjective such as indicated, marginal, or inferred, it is to be considered synonymous with the demonstrated-economic category, as shown in figure 1.

3. Definitions of resource categories can be modified for a particular commodity in order to conform with accepted usage involving special geological and engineering characteristics. Such modified definitions for particular commodities will be given in forthcoming government publications.

4. Quantities, qualities, and grades may be expressed in different terms and units to suit different purposes, but usage must be clearly stated and defined.

5. The geographic area to which any resource/reserve estimate refers must be defined.

6. All estimates must show a date and author.

7. The *reserve base* is an encompassing resource category delineated by physical and chemical criteria. A major purpose for its recognition and appraisal is to aid in long-range public and commercial planning. For most mineral commodities, different grades and tonnages, or other appropriate resource parameters, can be specified

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for any given deposit or area, or for the Nation, depending on the specific objectives of the estimators; therefore, the position of the lower boundary of the reserve base, which extends into the subeconomic category, is variable, depending on those objectives. The intention is to define a quantity of in-place material, any part of which may become economic, depending on the extraction plans and economic assumptions finally used. When those criteria are determined, the initial reserve-base estimate will be divided into three component parts: reserves, marginal reserves, and a remnant of subeconomic resources. For the purpose of Federal commodity assessment, criteria for the reserve base will be established for each commodity.

8. *Undiscovered resources* may be divided in accordance with the definitions of *hypothetical* and *speculative resources,* or they may be divided in terms of relative probability of occurrence.

9. *Inferred reserves* and the *inferred reserve base* are postulated extensions of reserves and of the reserve base. They are identified resources quantified with a relatively low degree of certainty. Postulated quantities of resources not based on reserve/reserve-base extensions, but rather on geologic inference alone, should be classified as undiscovered.

10. Locally, limited quantities of materials may be produced, even though economic analysis has indicated that the deposit would be too thin, too low grade, or too deep to be classified as a reserve. This situation might arise when the production facilities are already established or when favorable local circumstances make it possible to produce material that elsewhere could not be extracted profitably. Where such production is taking place, the quantity of in-place material shall be included in the reserve base, and the quantity that is potentially producible shall be included as a reserve. The profitable production of such materials locally, however, should not be used as a rationale in other areas for classifying as reserves, those materials that are similar in thickness, quality, and depth.

11. Resources classified as reserves must be considered economically producible at the time of classification. Conversely, material not currently producible at a profit cannot be classified as reserves. There are situations, however, in which mining plans are being made, lands are being acquired, or mines and plants are being constructed to produce materials that do not meet economic criteria for reserve classification under current costs and prices, but would do so under reasonable future expectations. For some other materials, economic producibility is uncertain only for lack of detailed engineering assessment. The marginal-reserves category applies to both situations. When economic production appears certain for all or some of a marginal reserve, it will be reclassified as reserves.

12. Materials that are too low grade or for other reasons are not considered potentially economic, in the same sense as the defined resource, may be recognized and their magnitude estimated, but they are not classified as resources. A separate category, labeled *other occurrences,* is included in figures 1 and 2.

13. In figure 1, the boundary between *subeconomic* and *other occurrences* is limited by the concept of *current or potential feasibility of economic production,* which is required by the definition of a resource. The boundary is obviously uncertain, but limits may be specified in terms of grade, quality, thickness, depth, percent extractable, or other economic-feasibility variables.

14. Varieties of mineral or energy commodities, such as bituminous coal as distinct from lignite, may be separately quantified when they have different characteristics or uses.

15. The amount of past cumulative production is not, by definition, a part of the resource. Nevertheless, a knowledge of what has been produced is important to an understanding of current resources, in terms of both the amount of past production and the amount of residual or remaining in-place resource. A separate space for cumulative production is shown in figure 1. Residual material left in the ground during current or future extraction should be recorded in the resource category appropriate to its economic-recovery potential.

16. In classifying reserves and resources, it is necessary to recognize that some minerals derive their economic viability from their coproduct or byproduct relationships with other minerals. Such relationships must be clearly explained in footnotes or in an accompanying text.

17. Considerations other than economic and geologic, including legal, regulatory, environmental, and political, may restrict or prohibit the use of all or part of a deposit. Reserve and resource quantities known to be restricted should be recorded in the appropriate classification category; the quantity restricted and the reason for the restriction should be noted.

18. The classification system includes more divisions than will commonly be reported or for which data are available. Where appropriate, divisions may be aggregated or omitted.

19. The data upon which resource estimates are based and the methods by which they are derived are to be documented and preserved.

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RESOURCES OF (commodity name)

[A part of reserves or any resource category may be restricted from extraction by laws or regulations (see text)]

AREA: (mine, district, field, State, etc.) UNITS: (tons, barrels, ounces, etc.)

Cumulative Production	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range (or)	
	Measured	Indicated		Hypothetical	Speculative
ECONOMIC	Reserves		Inferred Reserves		
MARGINALLY ECONOMIC	Marginal Reserves		Inferred Marginal Reserves		
SUB-ECONOMIC	Demonstrated Subeconomic Resources		Inferred Subeconomic Resources		

Other Occurrences	Includes nonconventional and low-grade materials

Author: Date:

FIGURE 1.–Major elements of mineral-resource classification, excluding *reserve base* and *inferred reserve base*.

RESOURCES OF (commodity name)

[A part of reserves or any resource category may be restricted from extraction by laws or regulations (see text)]

AREA: (mine, district, field, State, etc.) UNITS: (tons, barrels, ounces, etc.)

Cumulative Production	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range (or)	
	Measured	Indicated		Hypothetical	Speculative
ECONOMIC	Reserve		Inferred		
MARGINALLY ECONOMIC	Base		Reserve Base		
SUB-ECONOMIC					

Other Occurrences	Includes nonconventional and low-grade materials

Author: Date:

FIGURE 2.–*Reserve base* and *inferred reserve base* classification categories.

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UNITS OF MEASURE

1 carat (diamond) =	200 milligrams
1 flask (fl) =	76 pounds, avoirdupois
1 karat (gold) =	one twenty-fourth part
1 kilogram (kg) =	2.2046 pounds, avoirdupois
1 long ton (lt) =	2,240 pounds, avoirdupois
1 long ton unit (ltu) =	1% of 1 long ton or 22.4 pounds
long calcined ton (lct)	excludes water of hydration
long dry ton (ldt) -	excludes excess free moisture
Mcf =	1,000 cubic feet
1 metric ton (mt) =	2,204.6 pounds, avoirdupois or 1,000 kilograms
1 pound (lb) =	453.6 grams
1 short ton (st) =	2,000 pounds, avoirdupois
1 short ton unit (stu) =	1% of 1 short ton or 20 pounds
1 troy ounce (tr oz) =	1.09714 avoirdupois ounces

COUNTRY GROUPINGS

Central economy countries - Comprised of the following:

Albania	Korea, North
Bulgaria	Laos
China	Mongolia
Cuba	Poland
Czechoslovakia	Romania
German Democratic Republic	U.S.S.R.
Hungary	Vietnam
Kampuchea	

TARIFF RATES

The Tokyo Round of negotiations completed in 1979 resulted in new tariff agreements with the developed nations of the world. The agreements placed most nations on a most-favored-nation (MFN) basis with generally lower rates to be phased in, or staged, over an 8-year period beginning January 1, 1980. Because of space restrictions, the only rates of the staging period that are shown under item 5 are those effective as of January 1, 1985 and January 1, 1987. During 1980, China and Tibet were included among those countries for which most-favored-nation rates apply.

The countries or areas for which non-most-favored-nation (Non-MFN) rates apply are the following:

Albania
Bulgaria
Cuba
Czechoslovakia
Estonia
German Democratic Republic and East Berlin
Indochina (any part of Cambodia, Laos, or Vietnam which may be under Communist domination or control)
Korea (any part of which may be under Communist domination or control)
Kurile Islands
Latvia
Lithuania
Outer Mongolia
Poland
Southern Sakhalin
Tanna Tuva
Union of Soviet Socialist Republics and the area in East Prussia under the provicional administration of the Union of Soviet Socialist Republics.

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OTHER PUBLICATIONS

Additional statistical, economic, and technologic data on mineral commodities are available in other publications of the Bureau of Mines and the Geological Survey.

Bureau of Mines

Minerals Yearbook - An annual publication which reviews the mineral industry of the United States and foreign countries. Contains statistical data on metals and minerals, and their products and includes information on economic and technical trends and developments. The Yearbook is published in three volumes: Volume I, Metals and Minerals; Volume II, Area Reports, Domestic; and Volume III, Area Reports, International.

Mineral Industry Surveys - Periodic statistical and economic reports designed to provide timely statistical data on production, distribution, stocks, and consumption of significant mineral commodities. The surveys are issued monthly, quarterly, or at other regular intervals, depending on the need for current data.

Perspectives - Reports which present timely data on mineral developments in foreign geographic areas.

Mineral Commodity Profiles - Periodic reports covering a single important mineral commodity and containing both current statistical data and text covering strategic uses and industry problems.

Bulletins - Reports which describe major Bureau investigations or studies that are considered to have permanent value.

Information Circulars - Reports which primarily compile, review, abstract, and discuss various activities and developments in the mineral industries

Reports of Investigations - Describe the principal features and results of minor investigations or phases of major investigations, to keep the mineral industries and the public informed on progress in original Bureau research.

These and other Bureau reports are described in the monthly release "New Publications--Bureau of Mines," which is available free upon request from the Branch of Editorial Services, Bureau of Mines, 4900 LaSalle Road, Avondale, Md. 20782.

Geological Survey

Professional Papers - Comprehensive reports on the results of resource studies and of topographic, hydrologic, paleontologic, and geologic investigations, including longer contributions to the literature on scientific and engineering subjects.

Bulletins - Either final or progress reports on the results of resource studies and of topographic and geologic investigations; shorter contributions to economic and general geology; and descriptions of Survey instruments and techniques.

Circulars - Timely scientifically sound and accurate reports for which a simpler and less permanent format is deemed adequate. In general, the treatment of the subject is less comprehensive and final, or the report is of relative local or restricted interest, or of relatively temporary usefulness.

Maps and Charts - Numerous maps and charts pertaining to mineral resource investigations are published These include: Mineral Investigations Field Studies Maps: and Mineral Investigations Resource Maps.

These Geological Survey publications are described in the monthly release "New Publications of the Geological Survey," which is available free upon request from the Branch of Distribution, Geological Survey, 1200 South Eads Street, Arlington, Va. 22202.

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Created in 1849, the Department of the Interior—America's Department of Natural Resources—is concerned with the management, conservation, and development of the Nation's water, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that parks and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States—now and in the future.

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